MECHANICAL ENGINEERING

June 1956

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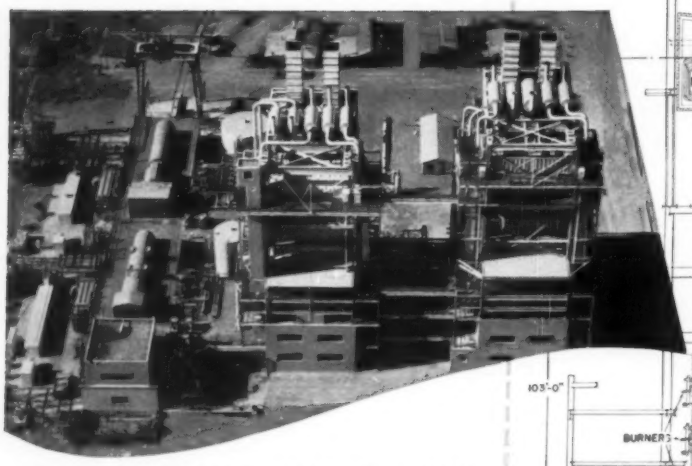
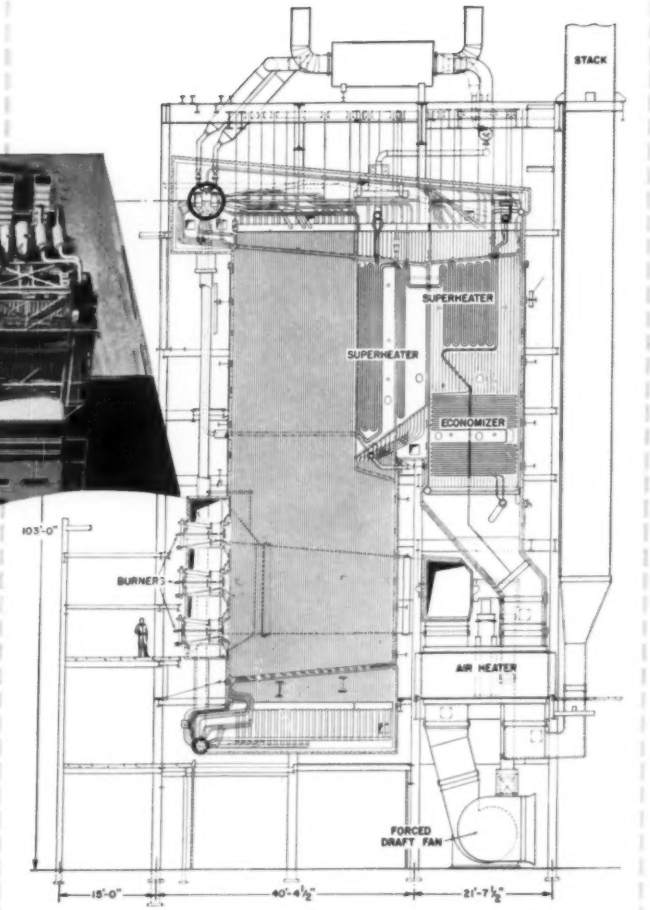
ASME Semi-Annual Meeting • Cleveland, Ohio • June 17-21, 1956



Air View of Parkdale Station of Dallas Power & Light Company. Consulting Engineers: Ebasco Services, Inc.



Modern Central Stations Serving America

Dallas Power & Light's PARKDALE STATION

Equipped with 3 B&W Boilers

Dallas Power & Light Company's current expansion program at Parkdale Station increases the Station's generating capability to 327,000 kw—to serve even better the mounting power needs of this important segment of the Great Southwest.

Of three B&W boilers at Parkdale Station, two are on the line and the third is under construction, scheduled to begin operation in 1957. Unit No. 1 serves 87,000 kw, Unit No. 2, 115,000 kw, and Unit No. 3, 125,000 kw.

The latest B&W unit chosen for Parkdale will provide 1,050,000 lb of steam per hour, with design pressure of 1725 psi, superheater outlet pressure of 1550 psi and temperature of 1005 F. This B&W Radiant Boiler has a pressurized furnace.

Parkdale is characteristic of the type of stations being built by electric companies in the Southwest; B&W is happy to share in this construction by providing technical advances gained through its continuing program of research and development—for increasingly efficient steam-electric power generation. The Babcock & Wilcox Co., Boiler Div., 161 East 42nd St., New York 17, N.Y.

G-764

BABCOCK & WILCOX

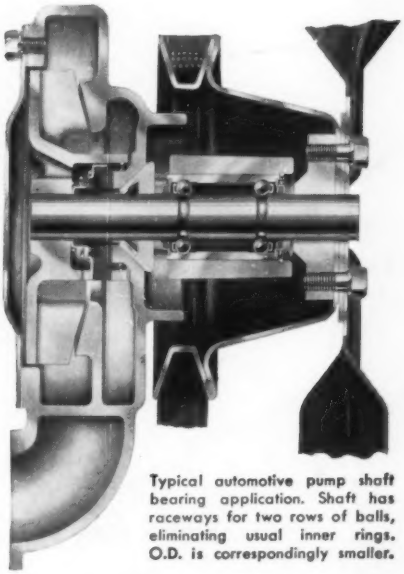
BOILER DIVISION

FACTS

about

NEW DEPARTURE

BALL BEARINGS



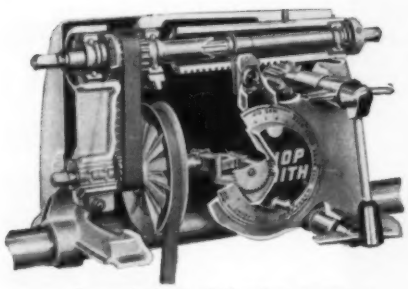
Typical automotive pump shaft bearing application. Shaft has raceways for two rows of balls, eliminating usual inner rings. O.D. is correspondingly smaller.

FAN AND PUMP SHAFT BEARING IS ADAPTABLE TO MANY USES!

This sealed and "lubricated-for-life" bearing with integral shaft was originated by New Departure specifically to simplify automotive fan and water pump mounting. Since its inception, it has reduced bearing maintenance requirements to virtually zero in millions of car, truck and other engines.

Because of its unique design and ability to locate parts on its shaft against loads from any direction, designers find it a highly *versatile* bearing, adaptable to many other uses.

The manufacturer of a well-known power tool, which combines several tools in one compact unit, employs the pump shaft bearing as a complete intermediate shaft with pulleys on one end and a keyway for tool attachment on the other, with obvious design and performance advantages.



Integral shaft of bearing serves as intermediate shaft in Magna's "Shopsmith". Assures fewer parts, easier machining, more accurate, quicker assembly.

Another manufacturer produces a power mower in which two of these versatile NEW Departures with hollow shafts not only support the mower rotors, but permit vertical adjustment of the wheel spindles to regulate cutting height.

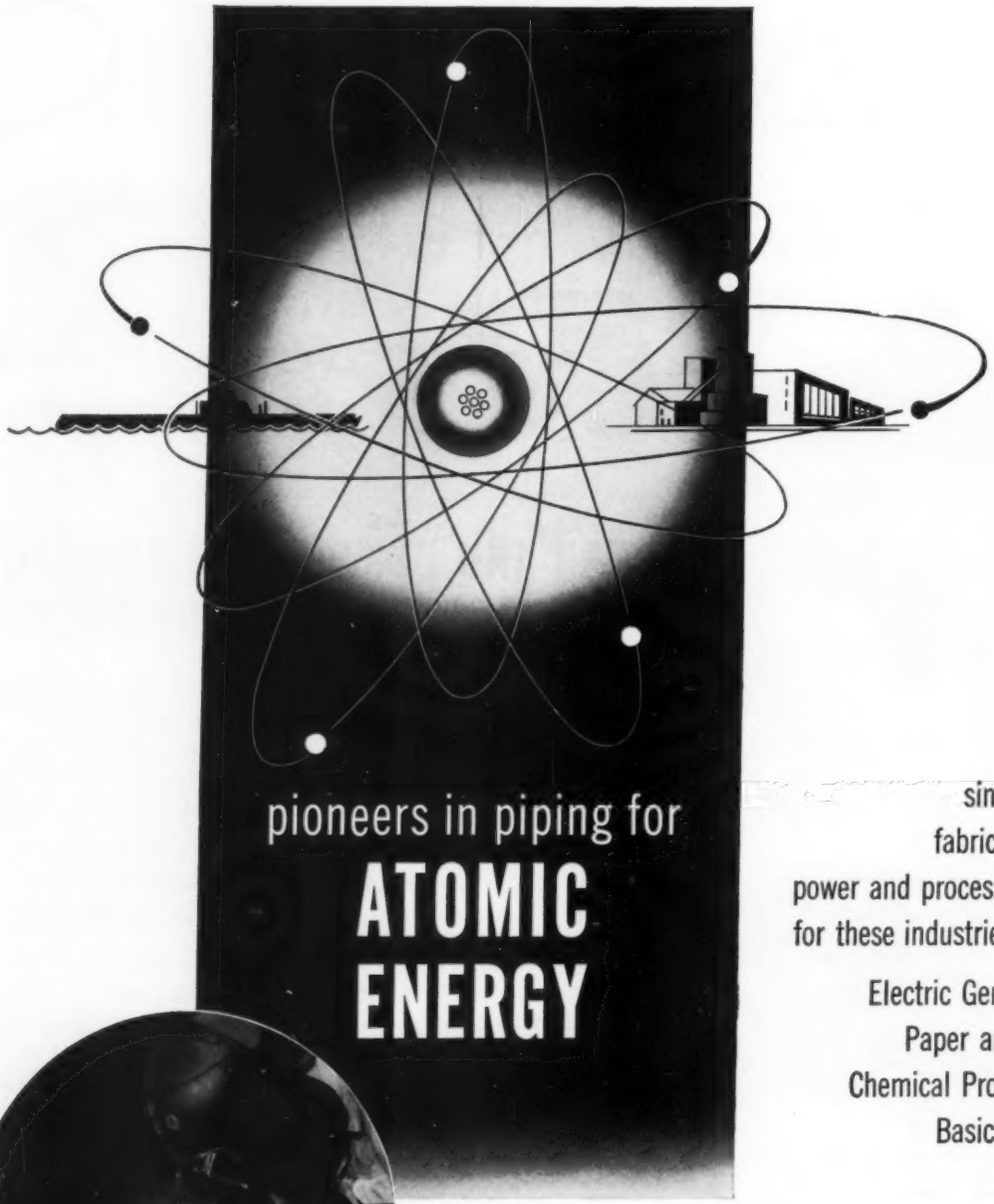
So here is another NEW Departure adaptable to many uses. New Departure engineers can show you what it and other ball bearings will do to improve your products.

FINE BALL BEARINGS MAKE GOOD MACHINES BETTER

For each McCulloch Mower, New Departure provides two pump shaft bearings with hollow shafts to permit vertical adjustments. Special heat treating gives full hardness at the raceways but adequate toughness in the shaft to withstand hard service.

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL; CONN.

MECHANICAL ENGINEERING, June, 1956, Vol. 78, No. 6. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members $3.50 annually, single copy 50¢; to nonmembers $7.00 annually, single copy 75¢. Add $1.50 postage to all countries outside the United States, Canada, and the Pan-American Union. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.



pioneers in piping for

ATOMIC ENERGY

since 1903
fabricators of
power and process piping
for these industries . . .

Electric Generating
Paper and Pulp
Chemical Processing
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Food
Textiles
Transportation
Manufacturing
Ordnance
Refining

P. P. & E. produced the first piping installations for marine and stationary nuclear power plants. Our facilities are complete —metallurgical research, laboratory service, engineering, shop fabrication, testing, and field erection. We have fabricated stainless steel piping for power and process industries since the middle 1920's.

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AND EQUIPMENT COMPANY
158 49th Street — Pittsburgh, Penna.

CANADA: CANADIAN PITTSBURGH PIPING, LTD.
835 BEACH ROAD—HAMILTON, ONTARIO

PP-17

Here's a story that COUNTS

. . . Tool Life INCREASED 33⅓% by using COPPERWELD 8620 LEADED ALLOY STEEL

A manufacturer of hydraulic pumps was averaging 7200 pieces per set of tools used in milling slots on this hydraulic pump rotor. By switching to Copperweld Leaded Steel, this tool life was increased to 9600 pieces.

In addition to longer tool life, leaded steel gives faster feeds and speeds, and a finer finish often eliminates a clean-up operation—truly, the steel with "built-in productivity." To put more operating profit in your production picture, try Copperweld Leaded Steels.

ARISTOLOY STEELS

Write for free booklet, "Lead Treated Steels."

COPPERWELD STEEL COMPANY • STEEL DIVISION • WARREN, OHIO

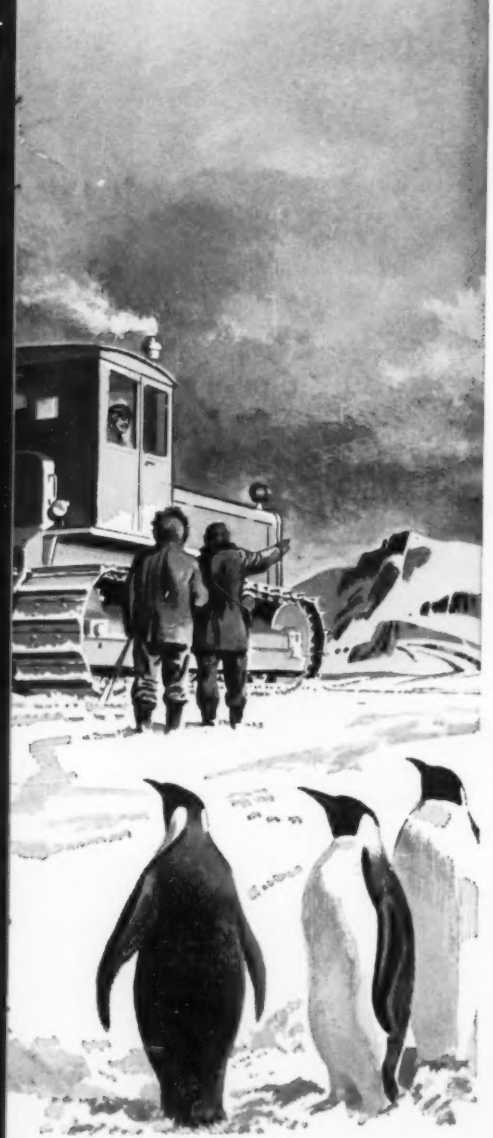
EXPORT: Copperweld Steel International Co., 225 Broadway, New York 7, N. Y.

Operation Deepfreeze sleds plow

IGY IS THE REASON. Scientists with the current Navy expedition to Antarctica will obtain scientific data on weather, atmospheric conditions, aurora and air glow, glaciers, geomagnetism, and allied subjects during the next International Geophysical Year (1957 and 1958). Tractor-drawn trains of cargo sleds, built by Otaco, Limited, Orillia, Ontario, Canada, will be used to haul supplies.

THE SKIS ARE MADE OF USS "T-1" STEEL. When the going gets rough, the runners on these cargo sleds are assembled into skis, 13 feet long and 34 inches wide, made of USS "T-1" Steel.

across Antarctica on tough skis of USS "T-1" Steel



DURING OPERATION DEEPFREEZE, the Navy's current expedition to Antarctica, thirty-eight rugged cargo sleds will be used to haul supplies 400 miles from Little America to Marie Byrd Land. The 11-ton sleighs, each carrying a load up to 20 tons, ride on skis made from tough ¼" plate of USS "T-1" Steel. The sleds were designed jointly by the United States Navy and Otaco, Limited, Orillia, Ontario, Canada.

Naturally, the skis had to be made from a steel that stays tough and durable at temperatures far below zero. The steel also had to possess high strength (to keep down weight), and excellent resistance to abrasion (to withstand the 400-mile trip across rugged, ice-covered terrain). In addition, the steel had to have good forming characteristics and be easily welded (to simplify fabrication).

One steel met all the requirements; that was USS "T-1" Steel. USS "T-1" Steel has a minimum yield strength of 90,000 psi . . . can be welded as easily as carbon steel, with the proper electrodes . . . has excellent resistance to abrasion and impact abuse . . . and remains tough at low temperatures. It was ideal for this tough job.

A VERSATILE NEW ALLOY STEEL

USS "T-1" Steel is adding strength and durability, cutting weight and costs, in steel mill equipment, power shovels, mine cars, bridges, coal handling equipment, pressure vessels, and many other applications, at high and low temperatures. It probably can help you improve your own product. Write for complete information. United States Steel, Room 5321, Pittsburgh 30, Pa.

UNITED STATES STEEL CORPORATION, PITTSBURGH
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS "T-1" CONSTRUCTIONAL ALLOY STEEL

USS

See the United States Steel Hour. It's a full-hour TV program presented every other week by United States Steel. Consult your newspaper for time and station.

UNITED STATES STEEL

U.S.P. PATENTED STAINLESS STEEL PROCESS

Centrifugally cast stainless steel pipe passes rigid specifications . . . including severe hydrostatic pressure test.

The men who design today's petrochemical plants, refineries or Atomic power plants are confronted with piping problems involving temperatures, pressures and corrosive conditions which only a few years ago would have been called impractical, if not impossible.

U. S. Pipe's Steel & Tubes Division recently completed a piping requirement for 700 feet of Type 316 Extra Low Carbon, columbium-bearing stainless for a large petrochemical plant, which is typical of the job metal mold centrifugally cast pipe is doing today under a patented manufacturing process with rigid Quality Control.

U. S. Pipe is headquarters for metal mold centrifugally cast alloy and stainless steel pressure pipe over a wide range of special and standard analyses — in large or small quantities.

Write and outline your refining problems. We may be able to help.

Note these exacting specifications on 316 Cb ELC Stainless Steel Pipe demanded by one of nation's leading oil companies:

Material Requirements: Pipe shall conform to ASTM Specification A-362-52T.

Chemical Analysis: Modified AISI Type 316 Cb (ELC), with *one percent* spread on chrome and nickel.

Finish: Each pipe to be turned, bored and faced to surface finish of 125 micro inch or better. O.D. tolerance plus 1/16" minus 0"; I.D. tolerance plus 0" minus 1/32".

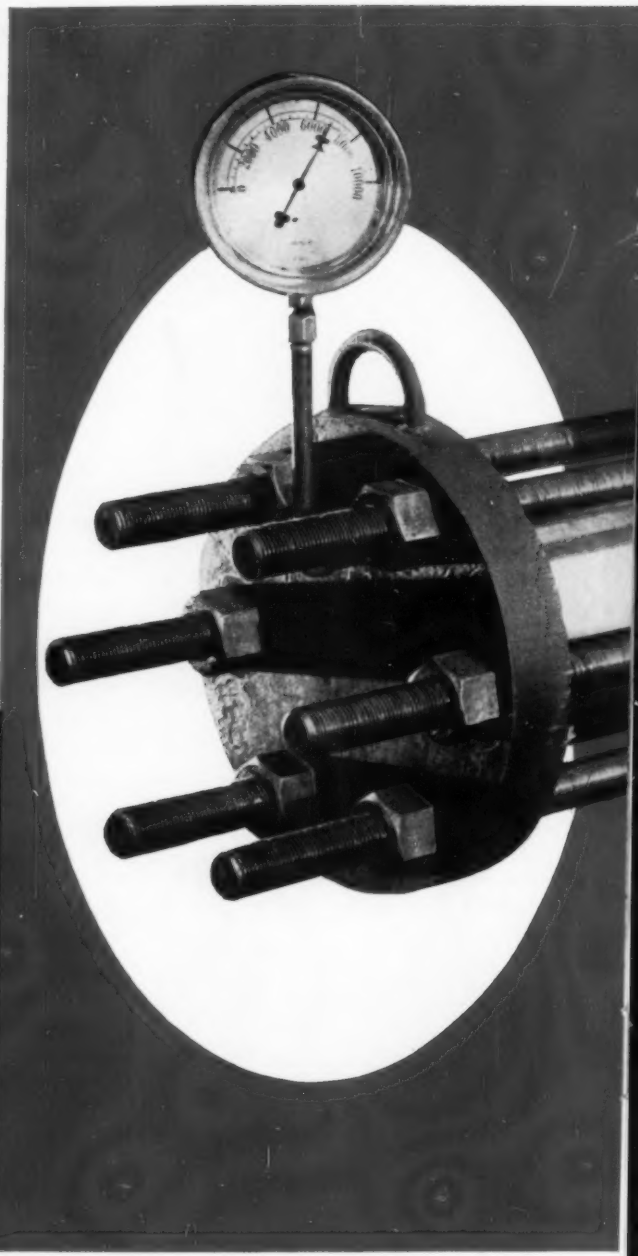
Mechanical Tests: Tensile Tests—2 tests required on each pipe after heat treatment; one at room temperature, one at 700° F.

Inspection Requirements;

1. Etching test on sections cut from each end of pipe.
2. Radiographic Inspection — Required complete circumferential coverage of at least an 8" wide section at each end of each pipe in accordance with ASTM Specification E71-52.
3. Fluid Penetrant — Entire O.D. and I.D. surface each piece.

Heat Treatment: Heat for 4 hours at 2100° F.—2150° F., water quench, follow by 5 hours at 1500° F.—1600° F. Cool in still air.

Hydrostatic Test: Each length tested to stress of either 90% of the minimum cold yield strength or a maximum pressure of 6800 psi — whichever is lower.



UPPER: Hydrostatic test rig used to qualify each length of pipe.

LOWER: Turned and bored stainless pipe is dimensionally accurate and furnished with superior I.D. surfaces.

MEETS RIGID PIPING REQUIREMENTS

UNITED STATES PIPE & FOUNDRY CO.

Steel and Tubes Division

BURLINGTON, NEW JERSEY

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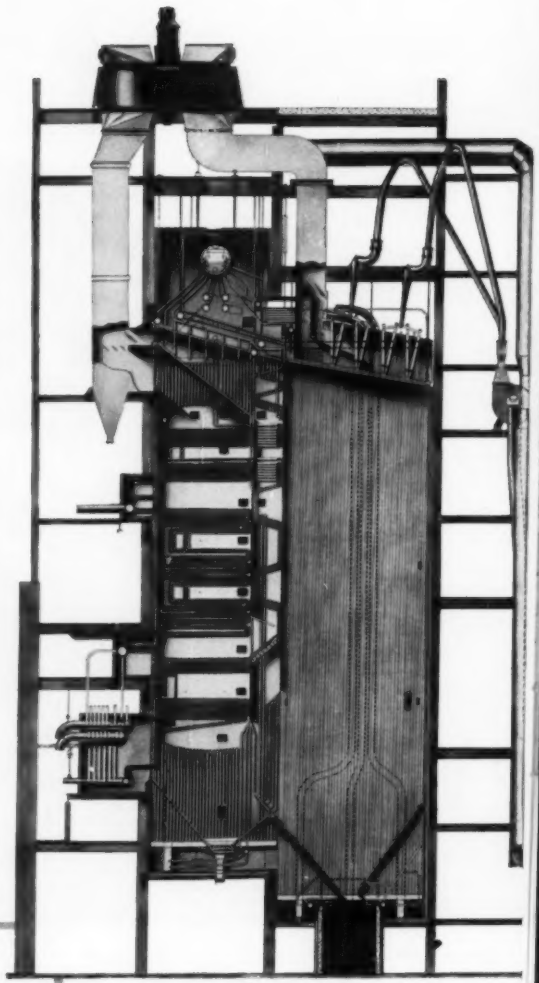
Now on the Line at Duquesne Light

1,060,000 lb/hr

Reheat Steam Generator by FW

Sixth Foster Wheeler Steam Generator at Phillips Station marks latest expansion of Duquesne system ... an expansion that will soon include atomic power at Shippingport, where FW Steam Generators will also serve



The capacity of the Phillips Station of Duquesne Light Company was increased by 156,200 kw when Unit No. 4 went on the line in January 1956. This, the largest and most efficient unit in the Duquesne system, is served by the 1,060,000 lb/hr Foster Wheeler reheat-type steam generator shown at the right.

The addition of Unit No. 4 brings total capability of Phillips Station to 382,000 kw. *All four* of these units are powered by Foster Wheeler steam generators — a tribute to customer satisfaction that dates back to the first installation in 1942.

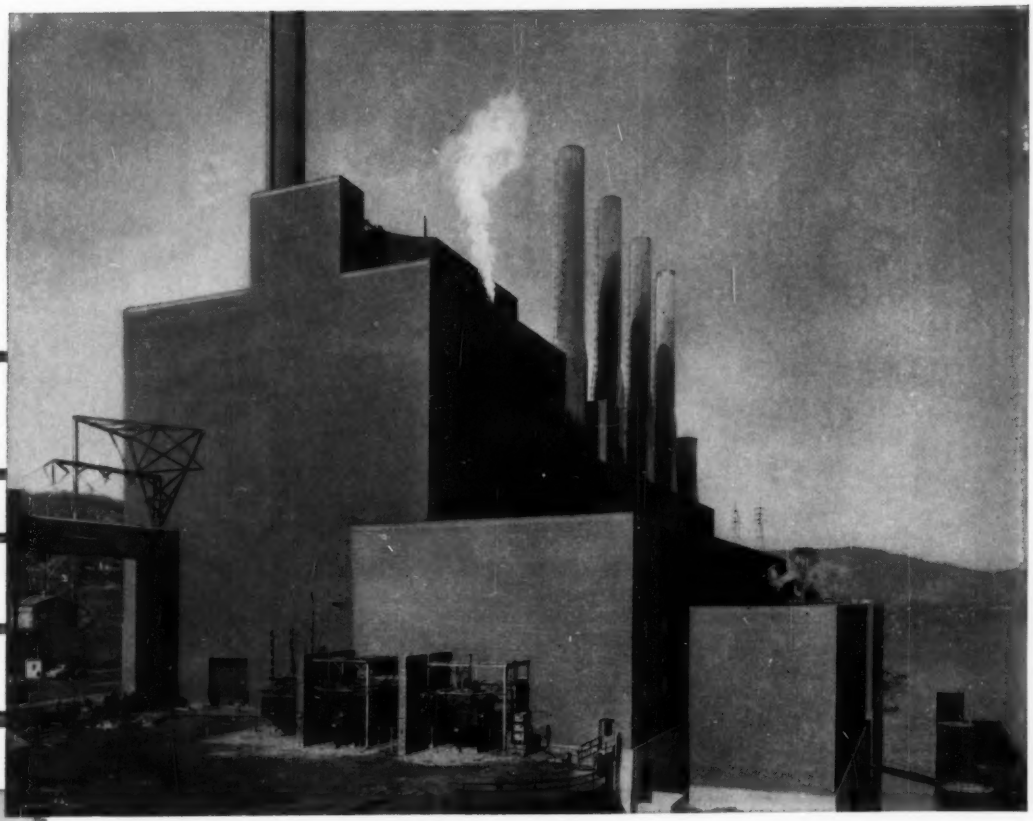
In the nation's first full scale atomic power plant, now under construction at Shippingport, Pa. and scheduled for completion in 1957, two Foster Wheeler steam generators (heat exchangers) will be used to convert heat from the nuclear reactor to 600 psi steam.

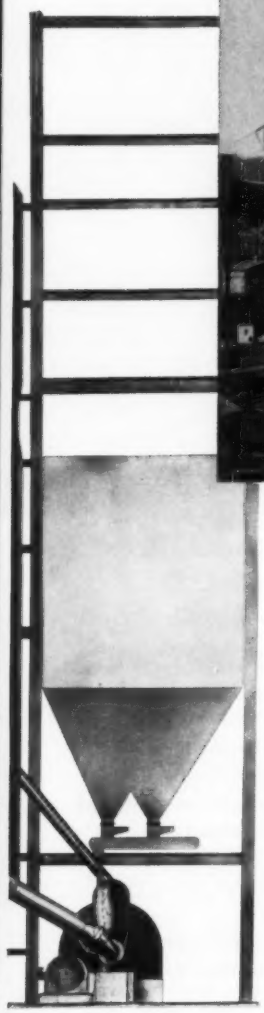
Whatever your Power Plant requirements — from coal or oil firing to nuclear energy — heat engineering by Foster Wheeler means efficient and dependable steam generation at low overall cost. For further information, write to *Foster Wheeler Corporation, 165 Broadway, New York 6, New York.*

FW STEAM GENERATORS AT DUQUESNE'S PHILLIPS STATION

1942 — TWO twin-furnace units, 500,000 lb/hr, 900 psi, 900F
1949 — ONE twin-furnace unit, 700,000 lb/hr, 900 psi, 900F
1950 — TWO twin-furnace units, 700,000 lb/hr 900 psi, 900F
1956 — ONE divided-furnace, reheat unit, 1,060,000 lb/hr, 1850 psi, 1000/1000F

Company's Phillips Station:





The FW steam generator for Unit No. 4 at the Phillips Station above is shown in cross section at the left. It delivers 1,060,000 lb steam per hour at 1,850 psi, 1,000F at the superheater outlet and 1,000 F reheat. The primary steam temperature is controlled at 1,000F over a load range from 689,000 to 1,060,000 lb/hr by spray control. Reheat temperature is also controlled at 1,000F over the same load range by gas by-pass.

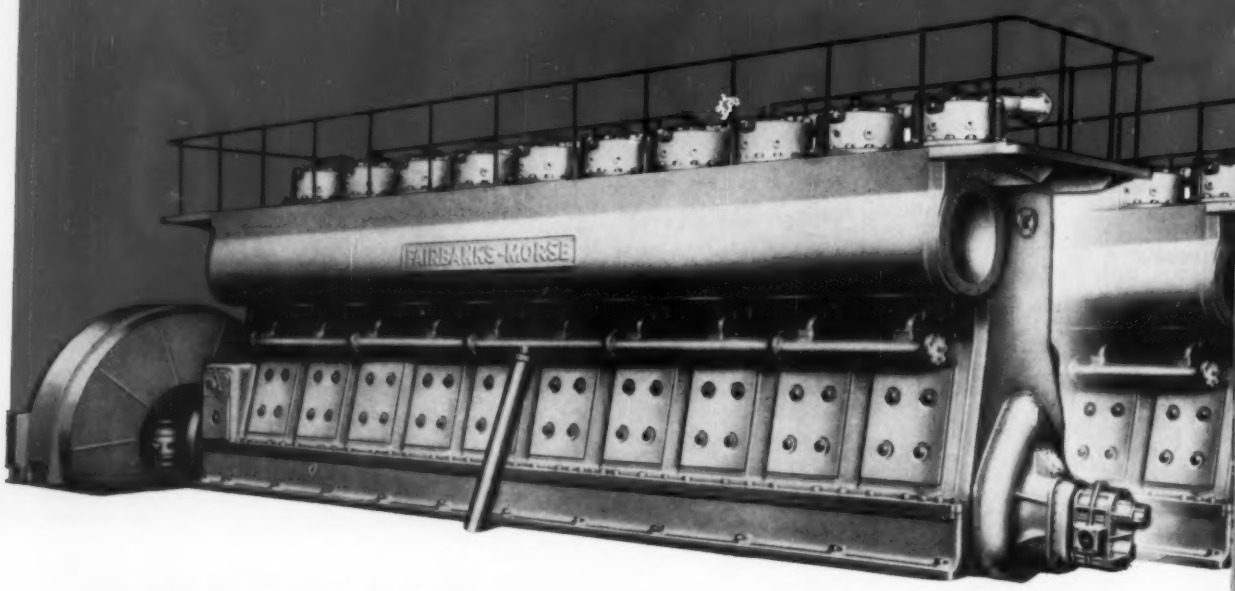
This 44-ft high furnace is vertically fired by 12 FW intertube burners located in the roof. The furnace is divided into three firing cells; the front, side and division walls containing waterwall surface while the rear wall is of radiant superheater surface. Furnace exit gases are divided into two passes, with convection superheater, convection reheater, and bare-tube economizer in the main pass, and convection superheater and extended-surface economizer in the by-pass section.

Coal for this 1,060,000 lb/hr unit is pulverized by two of the largest ball mills ever installed. These Foster Wheeler D-8D suction-type ball mills have a capacity of 67,000 lb of coal per hour, ground to a fineness of not less than 75% through a 200 mesh sieve and not less than 99% through a 50 mesh sieve. The pulverized coal-air stream is drawn from both ends of the double-ended mills and piped to four distributors near the top of the furnace, each distributor dividing it three ways so that each pulverizer exhaust feeds a burner in each of the three furnace cells. This assures a very even distribution of heat across the furnace.

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

Fairbanks-Morse tops REA



Record 43,300 Hp. Performance

In the top four plants of the national REA competition, there is more than two and a half times as much Fairbanks-Morse horsepower as in all other engines combined—a total of 43,300 horsepower.

Never before has there been such a clear-cut record of efficiency, on such a broad base, in favor of any engine in this competition.

Look at some of the figures:

- First, F-M horsepower produced more than 2/3 of the total power generated by the top four winning plants.
- Three 3500 horsepower Model 31A's generated 82% of the power in the top award-winning Johnson plant.
- Two exclusive F-M powered plants placed second and fourth with only a spread of .1 mill between them.
- One Model 31 in the Top Plant carried the highest penalty of longest operation on straight oil—yet efficiency was higher than plant average.

Here, in engine after engine, is a record of operating standards of efficiency unequaled by any other engine in such numbers.

You Can't Make a Better Power Buy Than a Fairbanks-Morse Diesel or Dual Fuel Engine

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

DIESEL AND DUAL FUEL ENGINES • DIESEL LOCOMOTIVES • RAIL CARS • ELECTRICAL MACHINERY • PUMPS • SCALES
HOME WATER SERVICE EQUIPMENT • MOWERS • MAGNETOS

mass efficiency competition

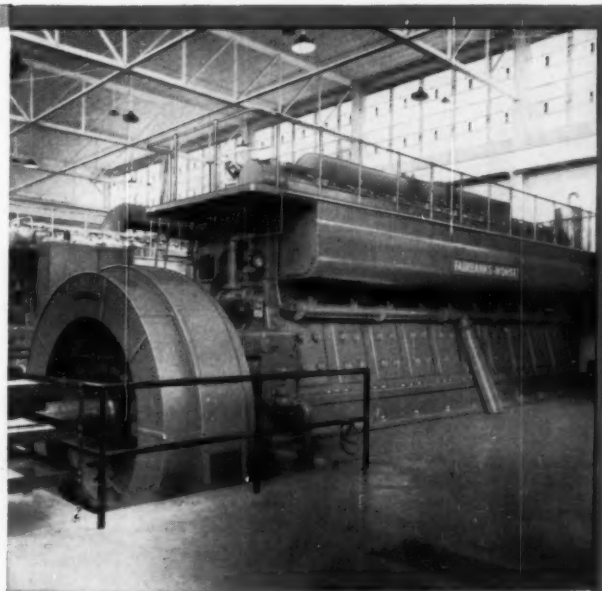
Outstanding Single Engine Performance

Engine No. 6 is one of three Fairbanks-Morse Model 31A 3500 horsepower engines that have helped keep the Johnson plant tops in efficiency for four years*. In winning previously, this engine set a record of 9213 BTU per kw-h—still unsurpassed by any engine today.

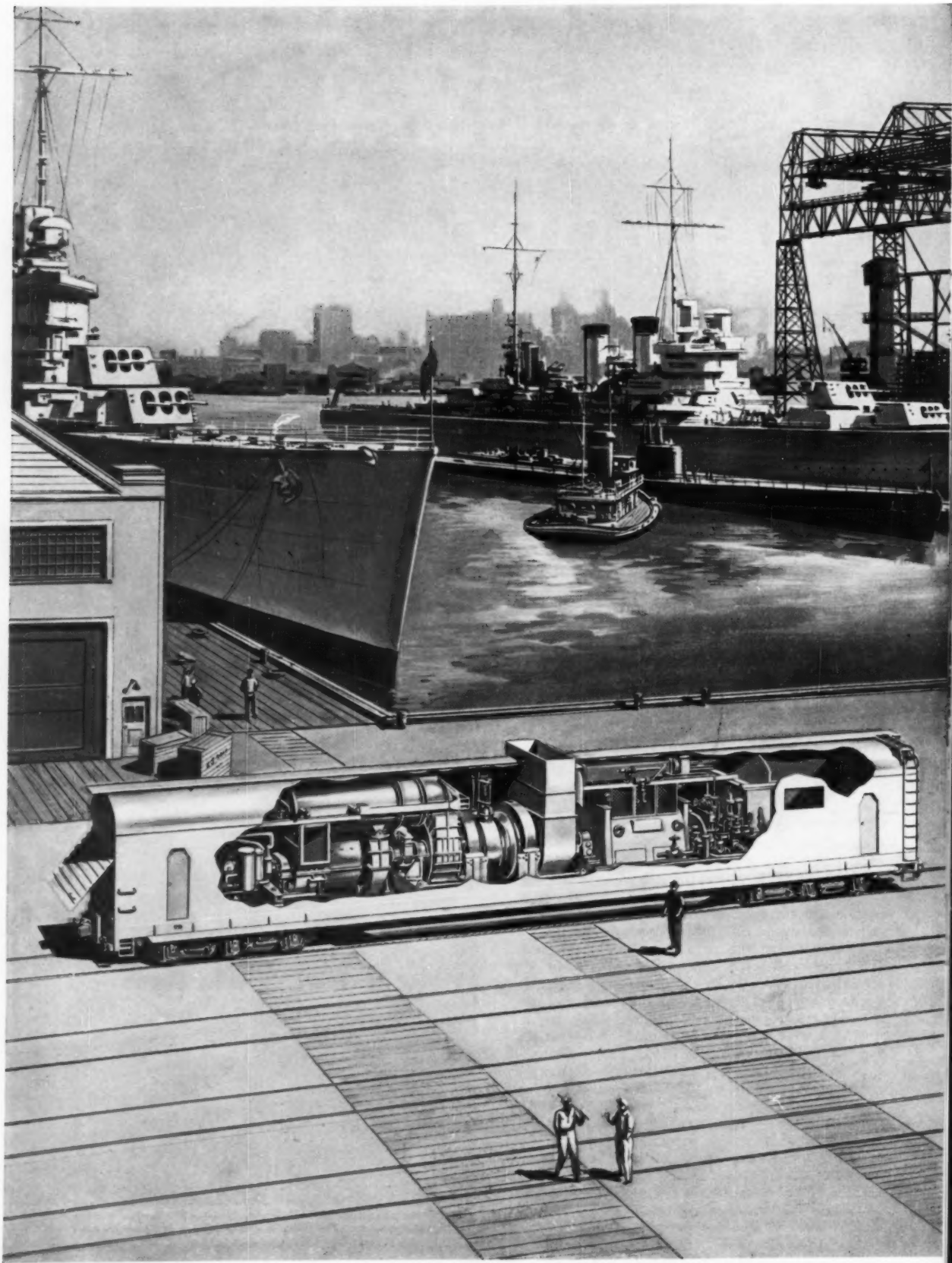
That winning record automatically selected the big No. 6 for the heaviest assignment to straight oil operation this year when gas supplies became short. *Yet*, the engine achieved an average of 9642 BTU per kw-h (Better than plant average) and during one period of operation maintained, an average of 8652.

That's approximately 40% thermal efficiency!

Under all conditions of load . . . penalties of straight oil operation . . . two high-altitude plant locations—close scrutiny of performance records of this year's winning plants clearly establishes the fact—you can't make a better buy than a Fairbanks-Morse Diesel or Dual Fuel Engine. Fairbanks, Morse & Co., Chicago 5, Ill.



*The Johnson plant also delivered top kw-h per BTU last year, but was eliminated from competition due to winning in two previous years



Clark Bros. Co. puts

5,500,000 watts on wheels

Completely self-contained on one railroad car and capable of safe travel at any train speed, this turbo-mobile power plant will deliver 5,500 KW within hours after reaching site where emergency power is needed. Conceived by the Bureau of Yards and Docks of the United States Navy, such a project had never been faced before and set up staggering problems of design and construction. Original specifications called for a minimum of 4,500 KW, but Clark Bros. Co., beat that by 25%, with additional overload capacity. The completely new type of gas turbine drive can use almost any available liquid or gaseous fuel. A one-man crew can operate it.

The ability of Clark Bros. Co., one of the Dresser Industries, to design and build this revolutionary new power plant springs from its 75 years of specialized manufacturing experience. "Precision by the ton" is literally true of Clark engines, compressors and turbines serving the world's basic energy industries.

Dresser integrated operating units quickly mobilized for unusual needs.

In their specialized spheres of service to the oil, gas, chemical, electronic and other industries, each Dresser company has a long background of successful individual performance. When special conditions arise or needs that are best answered by supplementary research, engineering or production facilities, all divisions of Dresser Industries, Inc. can be mobilized into effective teamwork for prompt action. This is the Dresser *Plus*+ performance which has made Dresser products and services a standard of comparison the world over.

Tomorrow's progress planned today

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TECHNICAL SERVICES

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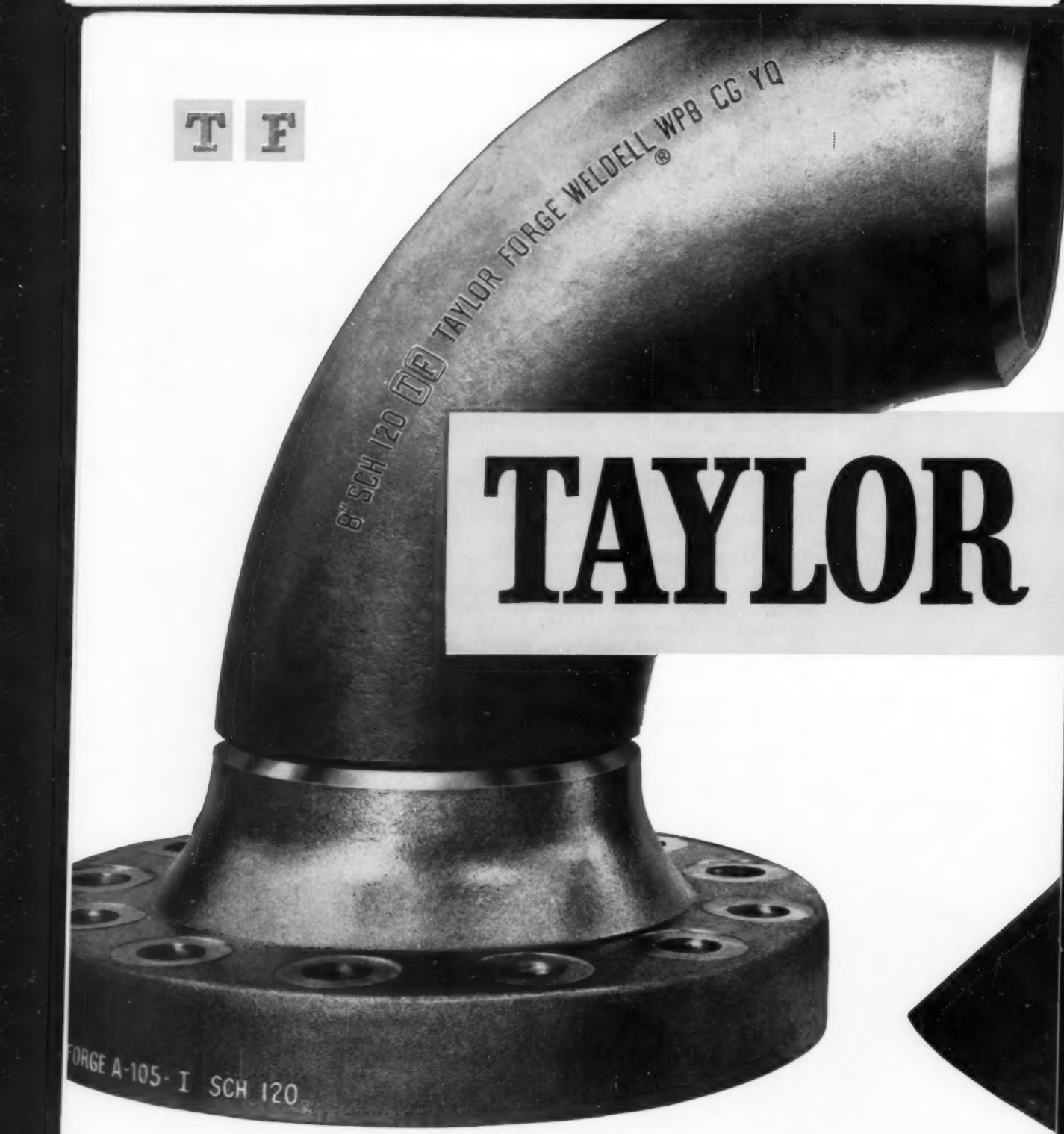


Welding nozzles

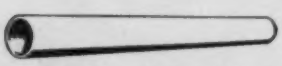
T.E.M.A. flanges and channels

Multiple outlet headers

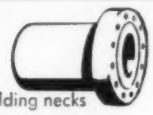
Production forgings

Venturi reducers

Spiral weld pipe



Large diameter electric weld pipe



Welding necks

Here's a rugged pair ready to be teamed up for a tough job

For utmost value on any piping job insist on

FORGE Welding Fittings and Forged Flanges

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* Engineered for unvarying accuracy
* Forged for maximum strength and stamina
* Guaranteed to meet all American Codes and Standards
* Available in every size, type, thickness, pressure rating and material

To be sure... turn to Taylor Forge

... TRADITIONALLY DEPENDABLE

Taylor Forge & Pipe Works

General Offices and Works: P. O. Box 485, Chicago 90, Illinois

Plants at: Carnegie, Pa.; Gary, Ind.; Houston, Texas; Fontana, Calif.; Hamilton, Ont., Canada.

District Sales Offices: New York, Philadelphia, Pittsburgh, Atlanta, Chicago, Houston, Tulsa, Los Angeles, San Francisco, Toronto, Calgary.

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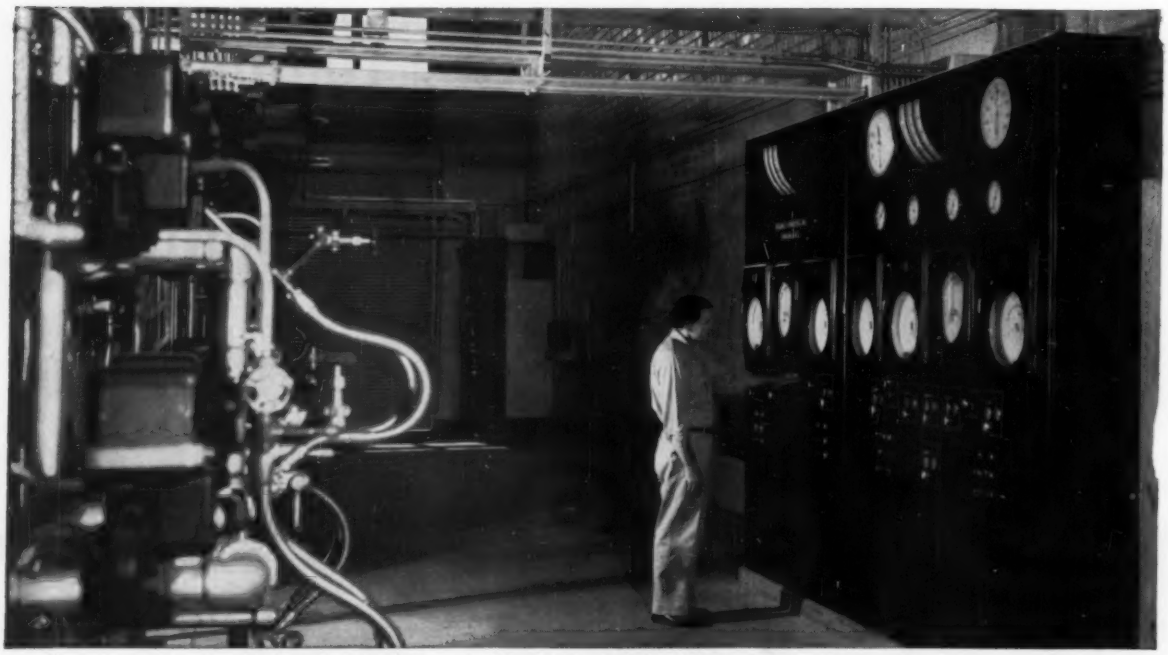
He carries a full stock of Taylor Forge Welding Fittings and Forged Flanges and can supply your needs promptly. He's a good man to know for he understands piping and through him you have available the services of Taylor Forge engineers for help and advice on any piping problem.



Anheuser-Busch's new Van Nuys, California, Budweiser brewery gets "big-station" boiler efficiency automatically with a complete Republic Combustion Control System centralized at this panel.

INDUSTRIAL POWER PLANTS CAN OPERATE AT CENTRAL STATION EFFICIENCY

● The power plant at Anheuser-Busch's new Budweiser brewery, Van Nuys, California is a good example of how a modern industrial plant has taken advantage of cost-cutting methods used by central stations. The plant has three 48,000 lbs./hr. gas or oil fired boilers which produce steam at 200 psi. All three boilers are operated and coordinated by a Republic Automatic Combustion Control System which:

1. **Automatically maintains constant steam pressure by controlling the heat input to the boilers in accordance with the boiler load.**
2. **Automatically maintains maximum combustion efficiency by simultaneously and continuously controlling a measured fuel and air input to the boiler.**
3. **Automatically maintains any desired load division between the boilers.**
4. **Automatically maintains correct draft in each furnace.**

In addition, a Republic two-element feed-water system which is tied into the combustion control system automatically adjusts the water supply to boiler requirements at all loads.

This "big-station" automatic control means *continuous* firing efficiency for Anheuser-Busch, assuring lowest fuel cost per pound of steam produced. Fixed costs are also reduced since boilers are operated to deliver all of their rated capacity during "peak" loads. Extra stand-by equipment is not necessary. Finally, chain-of-event troubles that are caused by improper operation of auxiliaries is avoided by smooth simultaneous adjustments made by the master control system.

Let Republic's combined experience in combustion control systems for both industrial plants and central stations help you operate your power plant more efficiently. No matter what size or type of boiler, load conditions, fuel firing or draft arrangement, Republic can design and produce a control system that will operate it for maximum efficiency—automatically. Write for full details.

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois

Production Boom Putting on Pressure for Greater Drafting Room Output?

Now IS THE TIME TO ACT *in Behalf of Your Company and Yourself!*

Chances are that your company, like most, is gearing up for greater-than-ever production. That means more and more pressure on your drafting department for engineering drawings and prints. You owe it to your company and yourself to equip your department, right now, to meet growing demands with greater output!

New, higher-production equipment and materials can help you do it! Never has there been a better opportunity to replace old, inadequate equipment with the efficient new products you've been wanting. With management's desire for greater production, you couldn't pick a better time to get approval for new equipment expenditures.

BRUNING

To discover for yourself how many ways you can boost drafting room output, yet save time and manpower, take a minute to look over the next three pages. You'll be glad you did!

Look How Many Ways You Save Time and Money With

Check the Places in Your Drafting Room Where Production Bottlenecks Can be Eliminated by Modern Bruning Products!

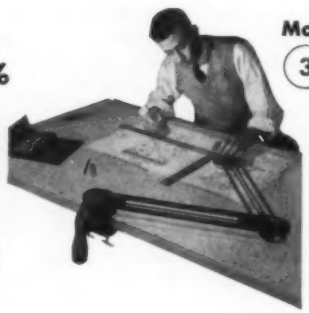
(1) Modern Copyflex Machines Speed Reproduction, Cut Operating Costs

Five new and advanced machine models introduced in just the last year! They offer you all the benefits of diazo black-on-white reproduction, plus problem-free installation and operation. No fumes, no exhaust ducts. They bring you faster reproduction speed and a host of operator conveniences such as fast return of originals, automatic separation, front or rear delivery. There's a Copyflex model to meet every need. New, better Copyflex sensitized materials work together with Copyflex machines to give you premium results.

JUST OUT! New Tabletop Model 300 with 30-inch printing width! Now the smallest engineering department can afford the advantages of "inside" reproduction with low-cost Model 300. The largest company can economically supplement its reproduction center with additional, strategically located Model 300s.

(2) Modern Bruning Drafters Speed Drafting up to 30%

Over conventional equipment, Bruning drafters speed drafting up to 30% on most jobs . . . up to 40% on some structural drawings. Patented "Equipoise" gravity compensator, exclusive touch control indexing provide unrivalled simplicity, precision, and ease of operation. Full range of models including Counterbalanced and Track Drafters. Standard or Civil Engineer protractor heads.



Modern Bruning Tracing Mediums (3) Speed Drawings, Enable Sharper Prints

These improved drawing mediums are unsurpassed for translucency, pencil-and-ink taking qualities, and permanence. You make drawings and tracings far easier and faster, get cleaner and sharper prints. Select from a complete variety.

Can Boost Drafting Room Output, New, Modern Bruning Products!

Why Let Old and Inadequate Equipment and Materials Stall Operations Now, When More and More Output Is Demanded of Your Department? Every Day You Delay Is Costing You Time and Money!

Here are the modern, higher-production products—some the newest on the market—that can help you boost drafting room output by replacing old and inadequate equipment and materials. A pioneer researcher in its field, Bruning still leads the way today with such developments as newly improved tracing papers and cloths that are setting a new standard in their field . . . newly improved sensitized materials that give you quality reproduction never before attainable . . . new, improved Copyflex machines that set a new high in quality, convenience, and economy of reproduction.

Researcher, manufacturer, and supplier . . . Bruning provides you a single, convenient, dependable source for everything you need in top-quality drafting room supplies and service. You simplify ordering and stocking, save time and money. Companion products, like Copyflex reproduction machines and Copyflex sensitized materials, are made to work together to give you premium results.

(4) Modern Hamilton Drafting Tables Provide up to 50% More Use of Floor Space

You can put six Hamilton Auto-Shift tables where you now have four boards with separate reference desks. The unique design of Auto-Shift increases the efficiency of draftsmen, reduces waste motion and fatigue. Bruning has a modern drafting table to suit every need and budget.

(5) Modern Hamilton UnitSystem Files Save Time, Space; Permit Orderly Expansion

You choose the individual filing units you need and combine them in an integrated and interlocking stack. You save time because drawings are easier to file and find. You make the most efficient use of space, expand your filing set-up in an orderly fashion.

More Products from Bruning to Help You Step up Production, Save Time and Money!

Modern Drafting Tools and Supplies Help Speed Draftsmen's Work

Bruning's wide selection includes not only standard items, but many special time-saving aids such as dotting pens, proportional dividers, planimeters, and Wrico lettering sets.

Modern Bruning Erasing Machines Save Hours of Manual Erasing

Do a neater, safer erasing job. Save hours of finger-cramping manual erasing. Patented hollow shaft permits use of extra-long, seven-inch eraser, prevents "fly-outs." Quiet, cool, vibration-free.

BRUNING *Gives You More to Help Boost Output* →

3 More Reasons

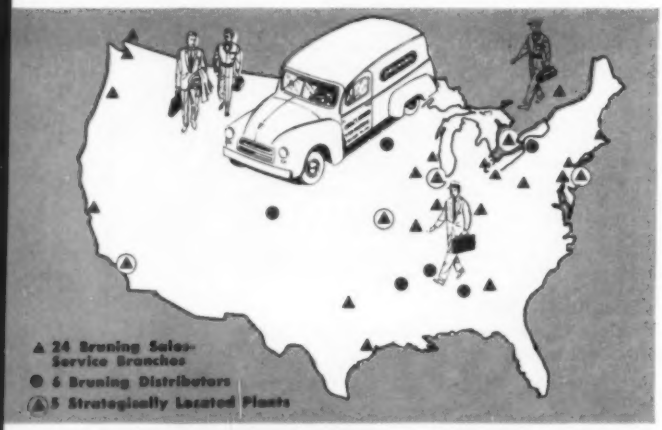
Why You Can Depend on Bruning to Help You Boost Drafting Room Output, Save Time and Money!

New and Better Products
—from Bruning Research and Engineering

In the past, it was Bruning Research and Engineering that introduced the first pencil tracing cloths, the first fume-free whiteprinters in America, the first band-type drafting machines. Today, by virtue of its modern laboratories and large engineering staffs, Bruning still leads the way in the development of new and better products. In just the past year, Bruning introduced five new, advanced reproduction machines . . . many newly improved tracing materials.

Consistently High Quality
—from Bruning Manufacturing

In its own modern paper converting plants at Teterboro, N. J., Chicago, Kansas City, Los Angeles, and Toronto, Ontario, Bruning controls quality all the way to bring you tracing mediums and sensitized materials of dependable, consistent high quality. The famous Copyflex reproduction machines are entirely Bruning manufactured to provide you the finest in reproduction performance.



The Product and Help You Need When You Need Them—from Bruning Sales Service

With the most comprehensive network of sales-service branches, distributors, and plants in its field, Bruning assures you of prompt, dependable service and supply. Your nearby Bruning branch is headquarters for a capable staff of Bruning sales-service specialists who are immediately available to you. Your nearby Bruning branch or distributor carries a full line of Bruning products and is staffed and equipped to give you fast, efficient supply. You suffer no costly delays for lack of supply or service.

America's Leading Supplier of
Engineering and Drafting Equipment

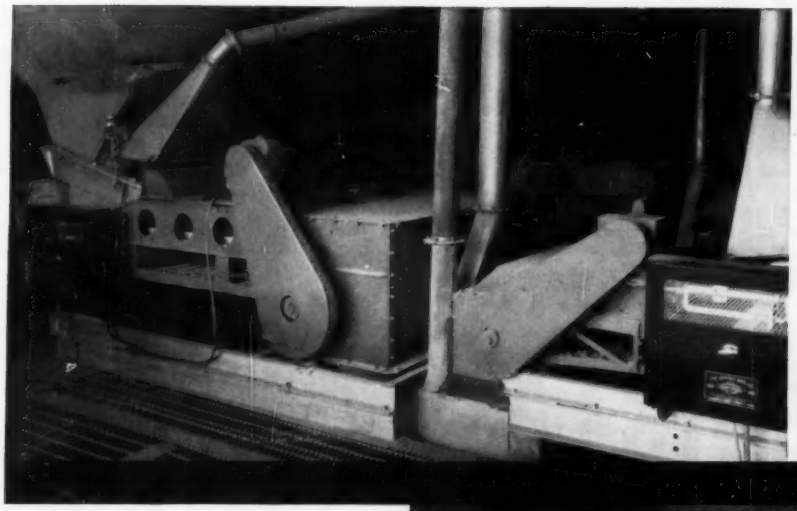
BRUNING

There you have it—the "big package" from Bruning to help you meet the demand for greater drafting room output! You get a complete line of modern, high quality products! You get better service. They work together to bring you better results at lower cost.

Charles Bruning Company, Incorporated
4700 Montrose Avenue, Chicago 41, Illinois
In Canada: Charles Bruning Company (Canada) Ltd.
105 Church Street, Toronto 1, Ont.

Printed in U.S.A.

WAYTROLS® feed an inferno with ± 0.1% accuracy



A metal producer reports ± 0.1% accuracy in proportioning with a pair of Jeffrey WAYTROLS.

Close formulation of the mixture as provided by WAYTROLS is vital to quality production in an electric furnace.

Mix an ore with slagging and reducing agents in the proper proportions. Apply the 3100° heat of an electric arc under carefully controlled conditions. Draw off the molten metal. Basically, that's the electrothermic process so widely employed today.

"Proper proportions" is the keynote to success. Inaccurate proportioning may ruin the entire process. Jeffrey WAYTROLS (continuous weigh feeders) help avoid that hazard.

WAYTROLS take materials from overhead hoppers and feed them at predetermined quantities or rates; so many ounces, pounds or tons per hour. They do this within the accuracy of the weighing equipment itself and without dependence upon the attention and judgment of the operator.

Weighing, batching and proportioning systems are described in Catalog 841. For a copy, write The Jeffrey Manufacturing Company, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT
TRANSMISSION MACHINERY • CONTRACT MANUFACTURING

what are your bearing requirements?

A different demand . . . or set of demands . . . is made of bearings in every different product. Chief considerations may be: minimum noise level . . . corrosion resistance . . . low unit cost . . . wear resistance to oscillating or sliding motion . . . operation in presence of moisture . . . or others. When considering a sintered metal bearing for your product, it is essential that you obtain the correct alloy. The wide range of GRAMIX alloys, together with the long experience of our engineering staff in working with bearing applications, assures you of getting the best possible bearing for your product.

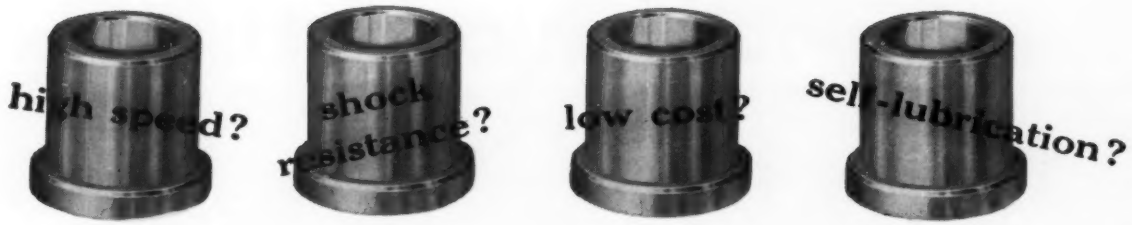
THERE IS A GRAMIX®

(A PRODUCT OF POWDER METALLURGY)

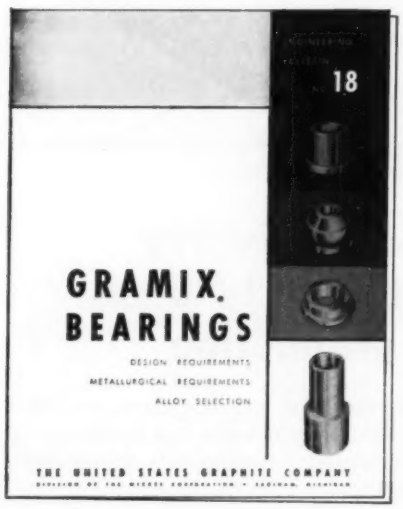
FOR YOUR

Certainly, there is such a thing as a "general purpose" sintered bearing alloy . . . GRAMIX Grade 81 fills this role, and does it well. But there are also applications that demand special alloys, designed to do a specific job better. There is a wide range of GRAMIX alloys to meet every individual design consideration. Properties of these alloys vary widely: tensile strengths range from 8,600 psi to 25,000 psi . . . elongations from 1% to 10%! Operating characteristics also vary. For example, under conditions where there is minimum lubrication, GRAMIX Grade 183 (copper, tin, lead, nickel) is recommended. For heavy duty operation in a surplus of oil, GRAMIX Grade 307 (copper, tin, lead, carbon) is preferred. These few facts convey an idea of the wide design range of GRAMIX alloys. There is *one* that exactly fits your product . . .

THE UNITED STATES



BEARING ALLOY DESIGN REQUIREMENTS



ENGINEERING BULLETIN No. 18

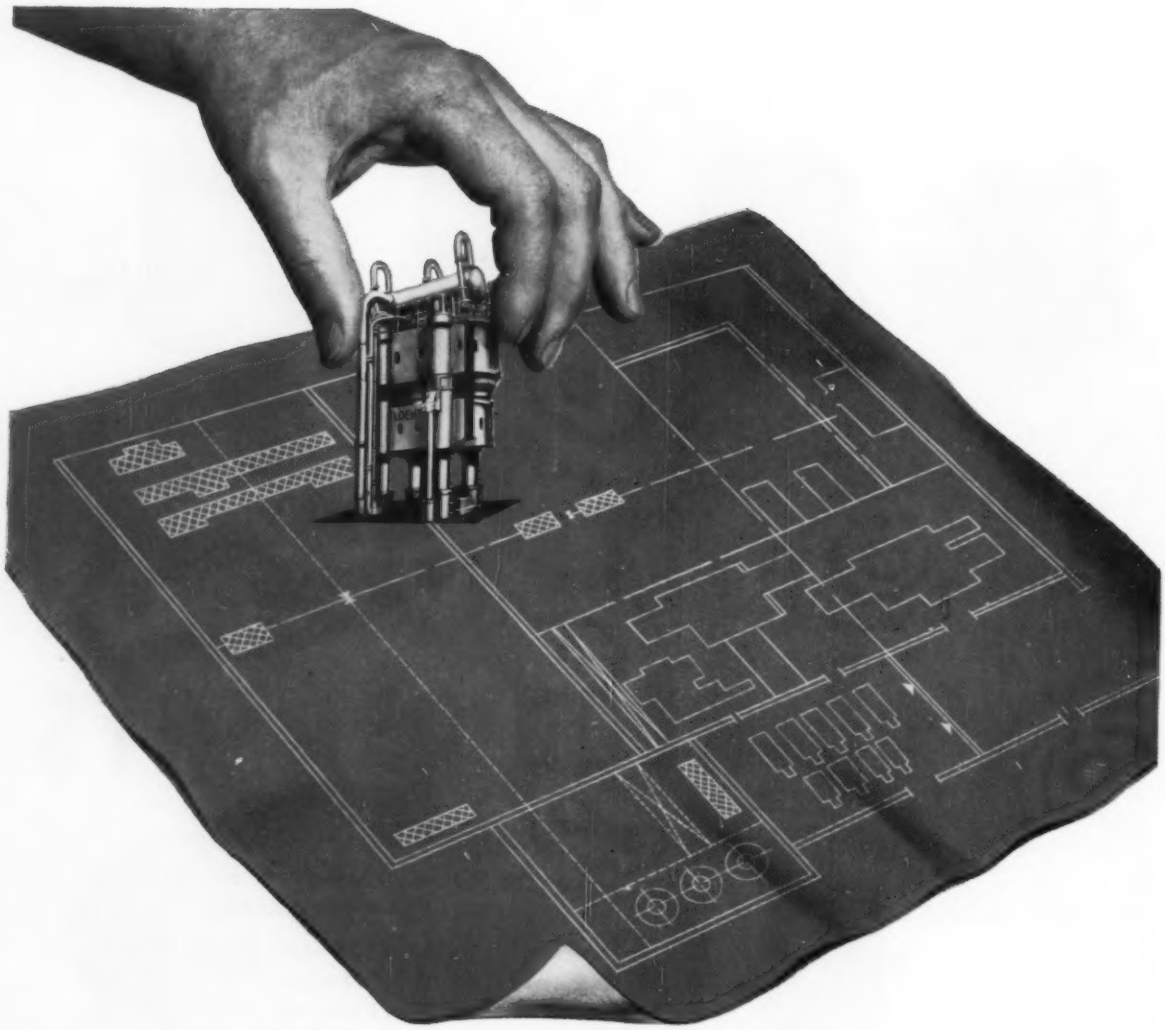
A NEW GRAMIX ENGINEERING BULLETIN TO HELP THE PRODUCT DESIGNER IN SPECIFYING SINTERED BEARINGS

Product engineers who specify bearing materials will find Engineering Bulletin No. 18 of great help. It presents in concise form much of the knowledge we have accumulated since 1924, when GRAMIX was first produced. Design requirements, metallurgical considerations, and alloy selection are all discussed. A table of data on GRAMIX alloy composition and physical characteristics such as density, tensile strength, elongation, and radial crushing strength is included. The section devoted to selecting the right GRAMIX alloy to fit greatly differing product requirements is an ideally simplified guide to this complex subject. Write for your copy of Engineering Bulletin No. 18 today.

113

GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN



how Loewy-Hydropress engineers can help you ... from plans to full scale production

Our staff of 400 engineers is at your service for any project, large or small. Here's what we offer:

- Research and development, including analysis of materials, methods, machinery operations, surveys and analytical reports.
- Design, construction and installation of forging presses, extrusion presses, powder metal presses, precision deep drawing presses, rolling mills—in fact, any equipment for metal forming and processing.
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Whether you require only preliminary consultation on an idea, or a complete "turn-key" job, you can depend on Loewy-Hydropress. For a copy of our bulletin L-144, write to Department 661, 350 Fifth Avenue, New York 1, N. Y.

BALDWIN BLH LIMA-HAMILTON

LOEWY-HYDROPRESS

BALDWIN-LIMA-HAMILTON

DIVISIONS: Austin-Western • Eddystone • Electronics & Instrumentation • Hamilton • Lima • Loewy-Hydropress • Madsen • Pelton • Standard Steel Works

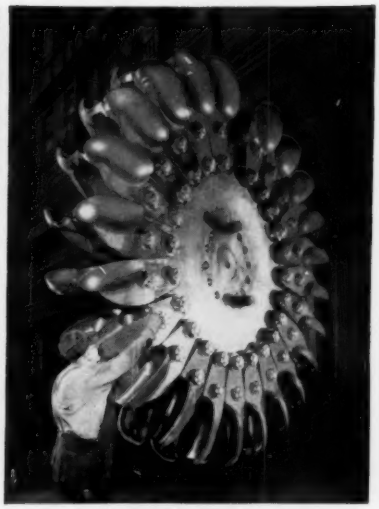
3 TYPES of Hydraulic Turbines

Propeller Type

Regularly chosen for low heads, up to 100 feet normally, and in exceptional cases even higher. Its higher speed effects appreciable savings in generator cost.

Francis Type

Used for heads up to 1000 feet — in some cases even higher heads — depending on the output capacity of the unit, the quality of operating water, and the character of load to be carried.



Impulse Type

For heads as high as pressure pipe lines can be built. Used for heads as low as 200 feet if water conditions prevent use of Francis type because of excessive wear.

ALLIS-CHALMERS Hydraulic TURBINES

Which is Best for Your Specific Needs?

ALLIS-CHALMERS WILL WORK WITH YOU and your consulting engineers to help decide. You'll take advantage of over 50 years' experience designing and building hydraulic turbines.

Besides building all three principal types of hydraulic turbines — Francis, propeller and impulse — Allis-Chalmers is in a unique position. It is the only company which can provide, in addition to the turbine, nearly all the other electrical equipment and auxiliaries needed. Generators, transformers, switchgear lead the list. The company can also provide pressure regulators, valves and governors for large units.

In many instances substantial savings can be realized by calling in Allis-Chalmers engineers to discuss the problem even before definite planning is begun. For all or any part of your needs, it will pay to contact the Allis-Chalmers representative nearest you. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, U. S. A.

A-4586

ALLIS-CHALMERS

Manufacturing Plants in United States and Canada

A-C ALLIS-CHALMERS

Over 14½ million installed horsepower of hydraulic turbines throughout the world.

"MONOBALL" SELF-ALIGNING BEARINGS

®

BORE SIZES UP TO 6" DIAMETER

ROD END TYPE

Tens of thousands in aircraft use. Backed by years of service life. Wide variety of Plain Types in bores sizes $^{3}/_{16}$" to 6" Dia. Rod end types in similar size range with externally or internally threaded shanks. Our Field Engineers welcome an opportunity of studying individual requirements and prescribing a type or types which will serve under your demanding conditions. Southwest can design special types to fit individual specifications. As a result of thorough study of different operating conditions, various steel alloys have been used to meet specific needs. New types have been developed, many as a result of specific requirements of our customers. Write or wire now for revised Engineering Manual.

PLAIN TYPE

Analysis

1. Chrome Moly Steel Ball & Race
2. Stainless Steel Ball & Race
3. Bronze Race and Chrome Moly Steel Ball

Recommended Use

1. For types operating under high radial ultimate loads (3000–893,000 lbs.)
2. For types operating under high temp. (800 – 1200 degrees F.)
3. For types operating under normal loads with minimum friction requirements.

★ SOUTHWEST PUSH-PULL CONTROLS ★

MECHANICAL COMPRESSION AND TENSION TYPE

POSITIVE remote manual control for actuating mechanical, hydraulic or electric devices. Southwest Controls remain in selected position and are not materially affected by changes in routing due to structure movement. Save on weight, simplify installations. Standard "O" rings seal both ends. Spherical shells in tube take the compression load and cable takes tension load.

Three Types

1. Light Duty—Compression Ult. Load 1250 lbs.; Ult. tension 960 lbs.
2. Heavy Duty—Compression Ult. Load 1650 lbs.; Ult. tension 960 lbs.
3. Extra Heavy Duty—Compr. Ult. Load 3050 lbs.; Ult. tension 3900 lbs.

Modernize your push-pull control system with Southwest Mechanical Push-pull Controls. Eliminate bell cranks, pulleys and dual cables. Send for ENGINEERING MANUAL giving detailed prints and complete specification covering materials, finishes, capacities. Please address Dept. ME-56.

★ ★ ★

Southwest Push-Pull Controls are used on Convair 240 and 340; Douglas DC-6, DC-6B, DC-7 and DC-8; Lockheed Constellation 949 and 1049; and other leading aircraft.

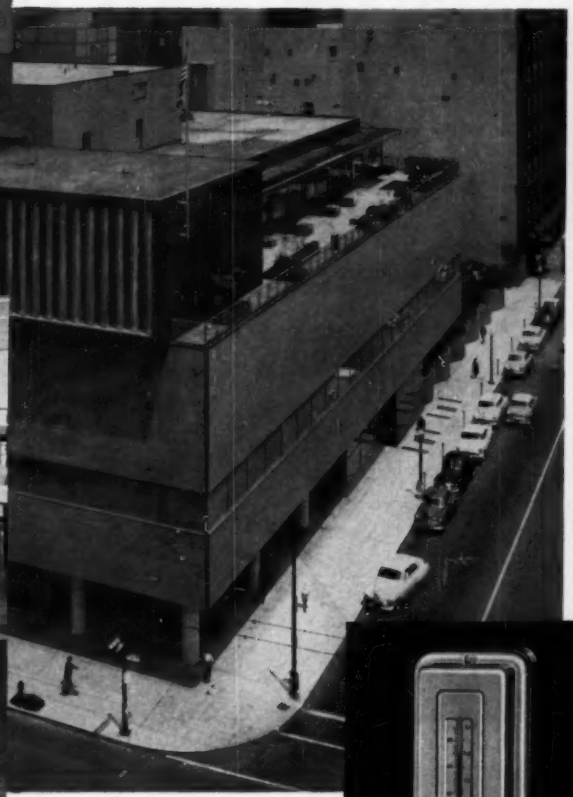
★

SOUTHWEST PRODUCTS CO.

Duarte, California

Cincinnati Public Library

Architects: WOODIE GARBER & ASSOCIATES
Associated Architects: SAMUEL HANNAFORD & SONS
Mechanical Engineers: WM. E. BODENSTEIN & W. W. SHUSTER
Htg. and Air Cond. Contractor: PECK-HANNAFORD & BRIGGS CO.



Ideal Comfort in this

Department Store of Knowledge

Is Assured by **POWERS** *Year 'round Air Conditioning Control System*

Cincinnati now has one of the nation's most colorful and attractive contemporary libraries. It is fully air conditioned.

Some of the Library's many features are: a children's room with child's size furniture, also a story hour room; film and recording center; a rare book room and director's room with stainless steel operable louvers on the exterior; rooftop terrace with planting boxes and reflecting pools; ground floor has a garden, pool and parking lot.

As modern as the building itself, is the Powers individual space control system which assures these important benefits: Maximum thermal comfort and fuel savings; low operating and maintenance cost; 25 to 40 years of reliable control with a minimum of repairs often reported by users.

Consult Powers on your temperature and humidity control problems. Experience gained here and in thousands of other significant buildings may be helpful to you.

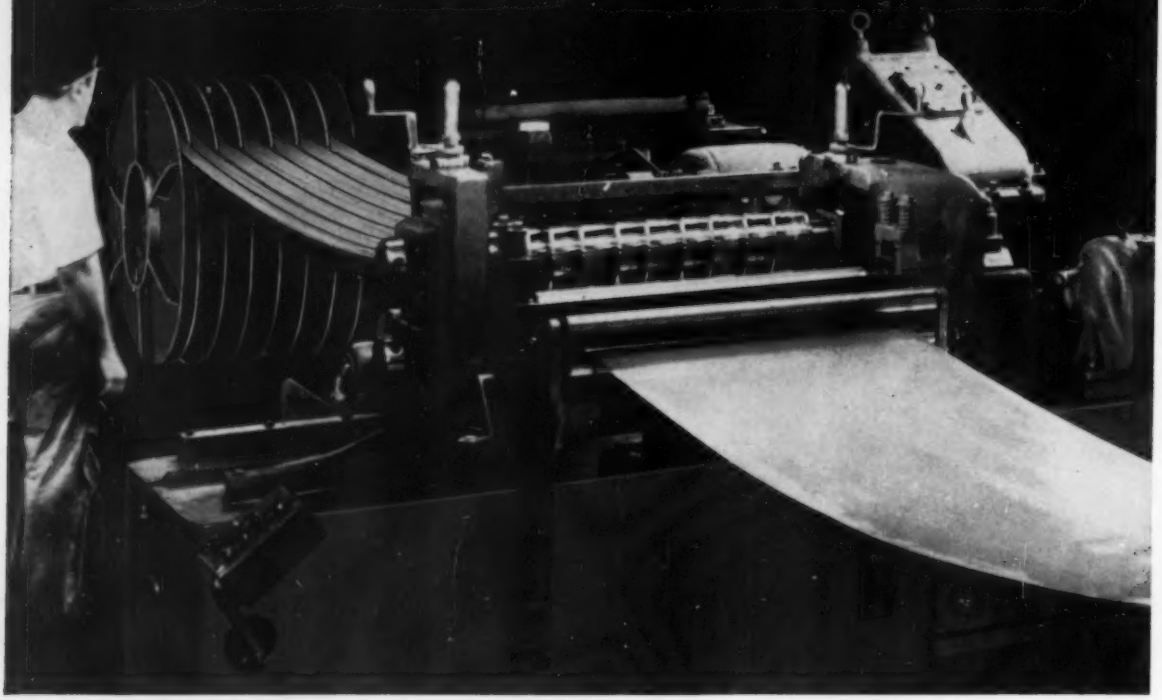
THE POWERS REGULATOR COMPANY

SKOKIE, ILLINOIS | *Offices in chief cities in U.S.A., Canada and Mexico*

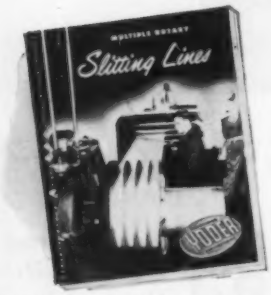
65 Years of Automatic Temperature and Humidity Control

(c61)

AN EFFICIENT SLITTING LINE



...with big savings possibilities



The Yoder Slitter Book contains time studies, production records, and other valuable data on the economics as well as mechanics of slitter operation. A copy is yours for the asking; also estimates and recommendations.

The standardized series of Yoder Uncoilers, Slitters and Recoilers make possible an infinite number of combinations for highly efficient coil and sheet slitting.

At a substantial saving in first cost, one of these combinations will meet widely varying production needs of fabricating shops as efficiently as higher priced, built-to-order equipment (also designed and built by Yoder) for very big tonnage requirements.

A Yoder standardized slitting line is a most profitable production tool which will pay for itself in short order on strip requirements as low as 100 tons per month, even less. Equally important is the ability in a few hours to meet expected and unexpected needs for slit strands, from a relatively small stock of standard width coils. This greatly reduces strip inventories and simplifies production planning.

THE YODER COMPANY • 5499 Walworth Avenue, Cleveland 2, Ohio

ENGINEERING YODER MANUFACTURING

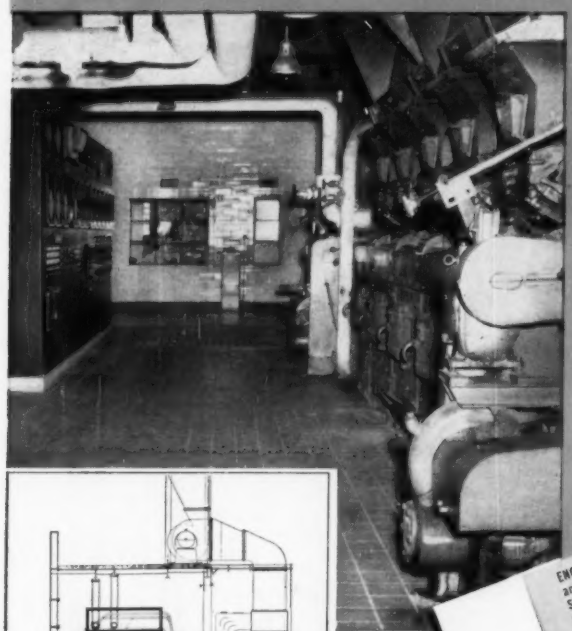
ROTARY SLITTING LINES

COLD ROLL FORMING MACHINES

ELECTRIC-WELD PIPE AND TUBE MILLS

J. S. PRODUCTION UP 10% WITH . . .

DETROIT ROTOGRATE STOKER

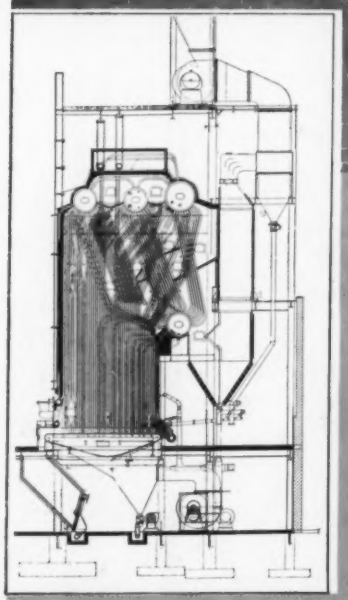


John Strange Paper Company, Menasha, Wisconsin Wins Power Modernization Award With New Steam Plant

• • •

Because so much steam is needed in paper making, the improved efficiency is reflected in a 10% increase in paper production. Since many costs remained the same, extra profits may be credited to the new steam generating equipment.

This includes a Union Type B four drum steam generator with superheater and economizer, fired by a Detroit RotoGrate Stoker. Capacity 165,000 pounds of steam per hour at 725 pounds pressure, 825° F temperature.



ENGINEERING and MANAGEMENT SECTION
John Strange Paper Co's modernized power plant is an outstanding example of . . .
Planning power services around a process
Power
A 1955 AWARD WINNER

Cummins & Barnard Inc., Consulting Engineers, Ann Arbor, Michigan, also received a citation from Power.

Write for reprints of this article.

Power MODERNIZATION PROGRAM

7380

DETROIT STOKER COMPANY

GENERAL MOTORS BLDG. • DETROIT 2, MICHIGAN

Welsbach High Pressure Service Gas Valve with Revere Arsenical Bronze Stem.
Welsbach Temperature-Pressure Relief Valve.
Welsbach Emergency Gas Shut-Off Valve, automatic.
Pressure Relief Valve for water heaters.

REVERE

Deep-Drilling Brass Rod

Increases Tool Life over 200% for Welsbach

Why not try it yourself?

In the manufacture of valves the Kitson Division of The Welsbach Corporation, Philadelphia, Pa., has to deep-drill brass rod. Originally the rod was free-machining brass. However, when Revere discovered the extent of the drilling it was suggested that our Mixture 252, Deep-Drilling Brass, would be preferable. This was tried, and the machine shop foreman reported that tool life was increased over 200%. In one item it is possible to bore with a single operation, against the former practice of withdrawing the drill three times in order to clear the chips. Revere's Deep-Drilling brass produces very small, easily cleared chips.

Another item is a high pressure gas valve, with a cast body and brass rod stem. The rod was changed to arsenical bronze, which costs a bit more, but it ended flaking and galling between stem and seat, and materially reduced rejects. Still another instance of Revere service concerns a hot water heater relief valve. The original model was cut out of bar stock. We suggested a high leaded brass tube, hexagon outside, round inside. This greatly reduces machining, has a better surface, and a better seat. Costs more by the pound, but saves more by the piece.

Revere salesmen and Technical Advisors are always glad to collaborate in seeking ways to save money and improve products. Perhaps we can help you!

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

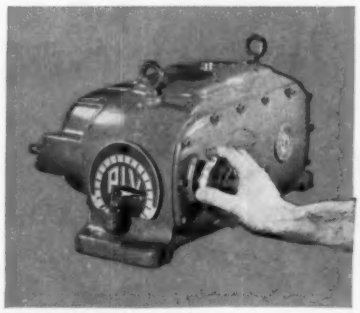
230 Park Avenue, New York 17, N. Y.

Mills: Baltimore, Md.; Brooklyn, N. Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere

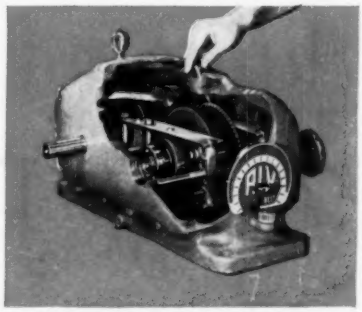
Because it uses a positive chain rather than frictional elements to transmit power...LINK-BELT P.I.V. delivers

variable speeds with unvarying accuracy

Throughout industry, chain drives have long been preferred as a simple, versatile method of transmitting power positively and accurately. But it was not until the conception of Link-Belt P.I.V. that this advantage was adapted to variable speed drives. With its self-tooth-forming chain principle, P.I.V. provides instant selection of any speed between its maximum and minimum settings without stopping the machine.

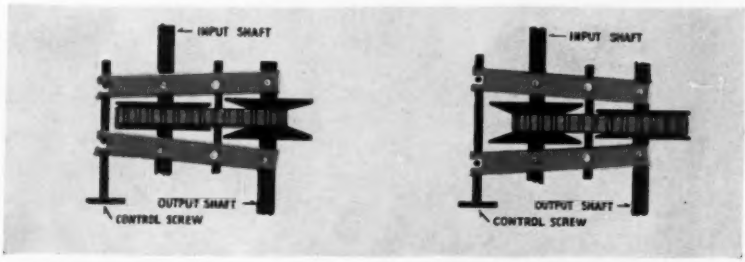


TO CHANGE OUTPUT RPM, operator merely turns convenient handwheel to selected speed, indicated by easy-to-read dial.



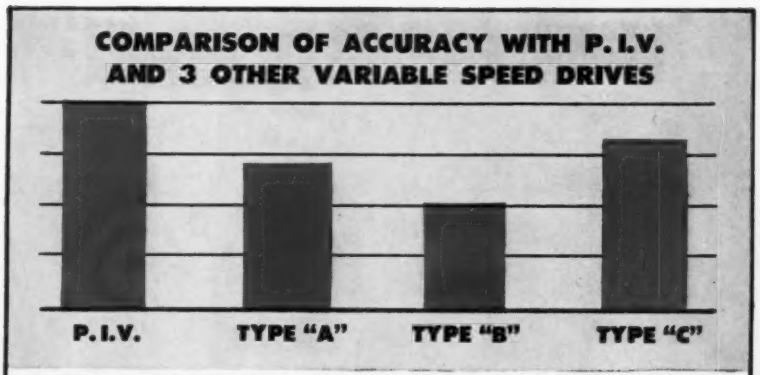
AUTOMATIC ADJUSTMENT of chain tension—by turning hand screw—assures accuracy during long life of drive.

P.I.V. drives are built in capacities from ½ to 25 hp, in 8 sizes and 16 types. Compactness permits installation as a separate unit or built-in part of driven machine.



AT MAXIMUM SPEED SETTING . . . chain grips wheel grooves near perimeter of input side and near center of output side.

AT MINIMUM SPEED SETTING . . . relative position of chain to wheels is reversed, delivering low output shaft rpm.



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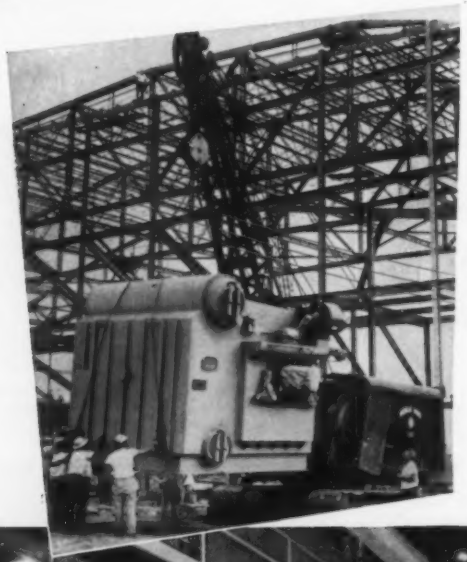

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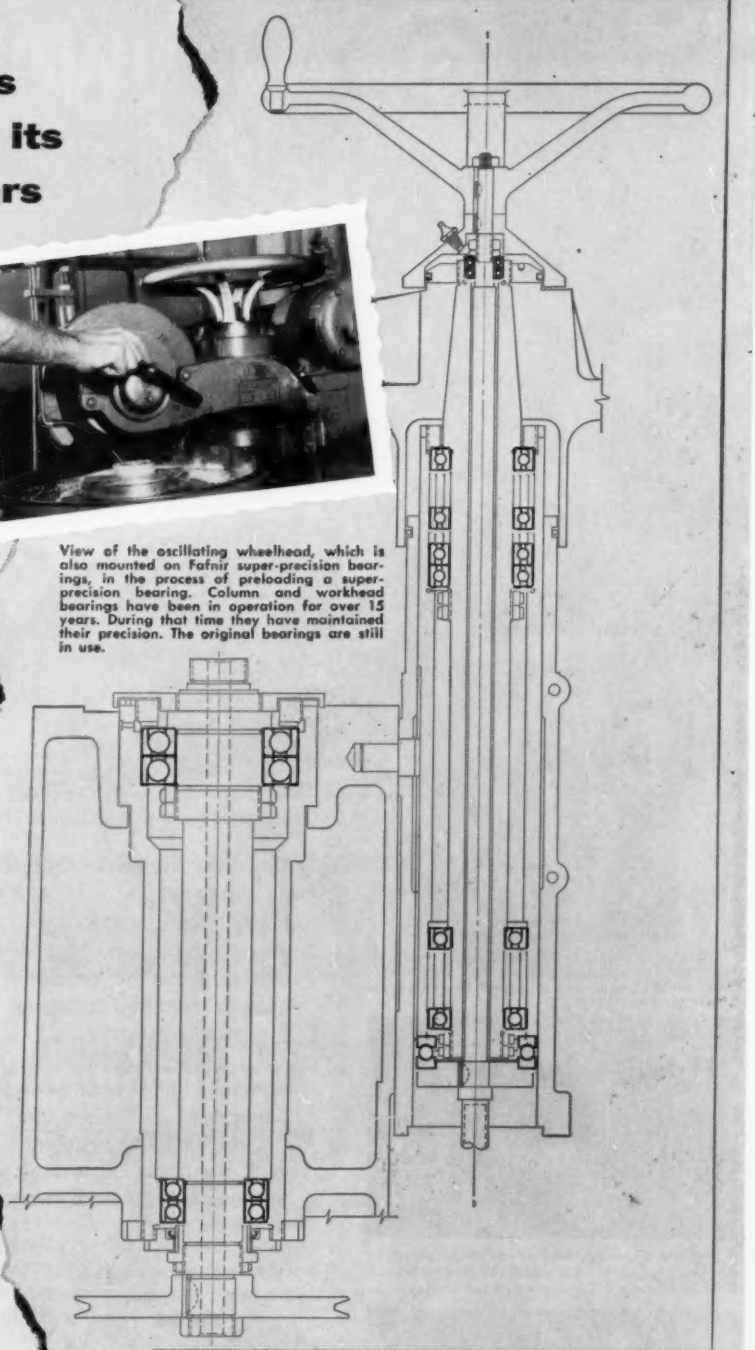
How a precision surface grinder is designed to hold its precision for years

The job of preloading super-precision ball bearings calls for grinding precise amounts of stock from the faces of bearing rings. To obtain such results with a satisfactory degree of efficiency requires a grinder designed to maintain maximum rigidity and precise swiveling of its wheelhead arm plus precise rotation of its work spindle.

The diagram at the right shows how such rigidity is built into a precision surface grinder. All bearings indicated except the thrust bearing at the bottom of the column which supports the wheelhead arm are Fafnir super-precision, preloaded types. The use of these Fafnir ball bearings has resulted not only in work of dependable accuracy and finish, but also longer machine life. For other application data on Fafnir super-precision bearings plus dimensional and load rating details, write for Fafnir Precision Ball Bearing Catalog. The Fafnir Bearing Co., New Britain, Conn.

View of the oscillating wheelhead, which is also mounted on Fafnir super-precision bearings, in the process of preloading a super-precision bearing. Column and workhead bearings have been in operation for over 15 years. During that time they have maintained their precision. The original bearings are still in use.



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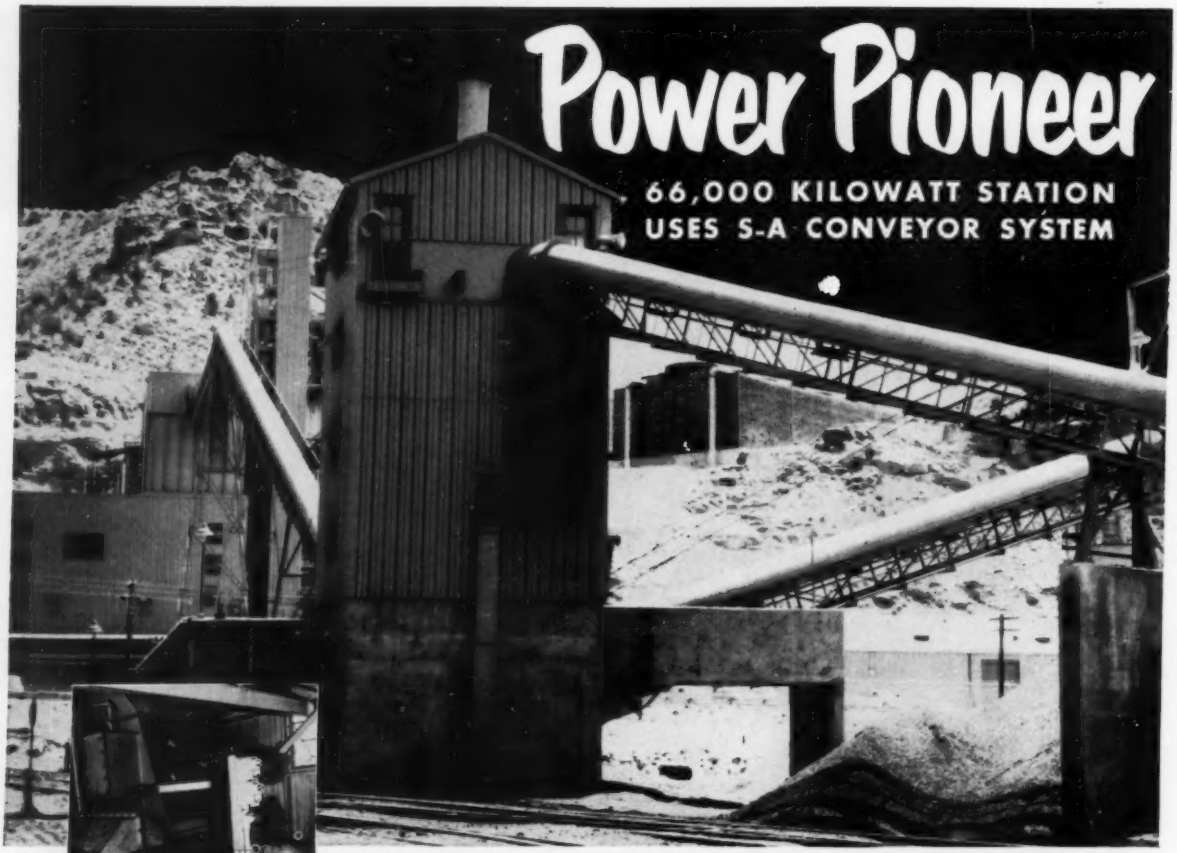
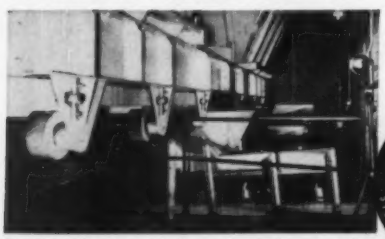


GENERAL VIEW OF CONVEYOR GALLERIES RUNNING TO AND FROM CRUSHER HOUSE

Double rotor knittel crusher processes 200 tons per hr. Coal is broken up by rotating twin sector gangs and dropped through size classifying grate.

Traveling tripper discharges 24 inch conveyor belt at any point into coal bunkers at either side of conveyor. Tripper covers a 55 ft. run.



Coal is discharged from track hoppers by twin S-A reciprocating plate feeders. Coal is moved underground at a rate of 200 tons per hour. Feeders are 40 in. wide by 14 ft. long.

The first steam-electric station to serve advancing power demands in the area, this Utah Power and Light Company plant depends for coal delivery on a conveyor system built and engineered by Stephens-Adamson. Tremendously rich in coal and other mineral deposits, the barren country around Price, Utah is destined to serve one of the nation's future great industrial centers.

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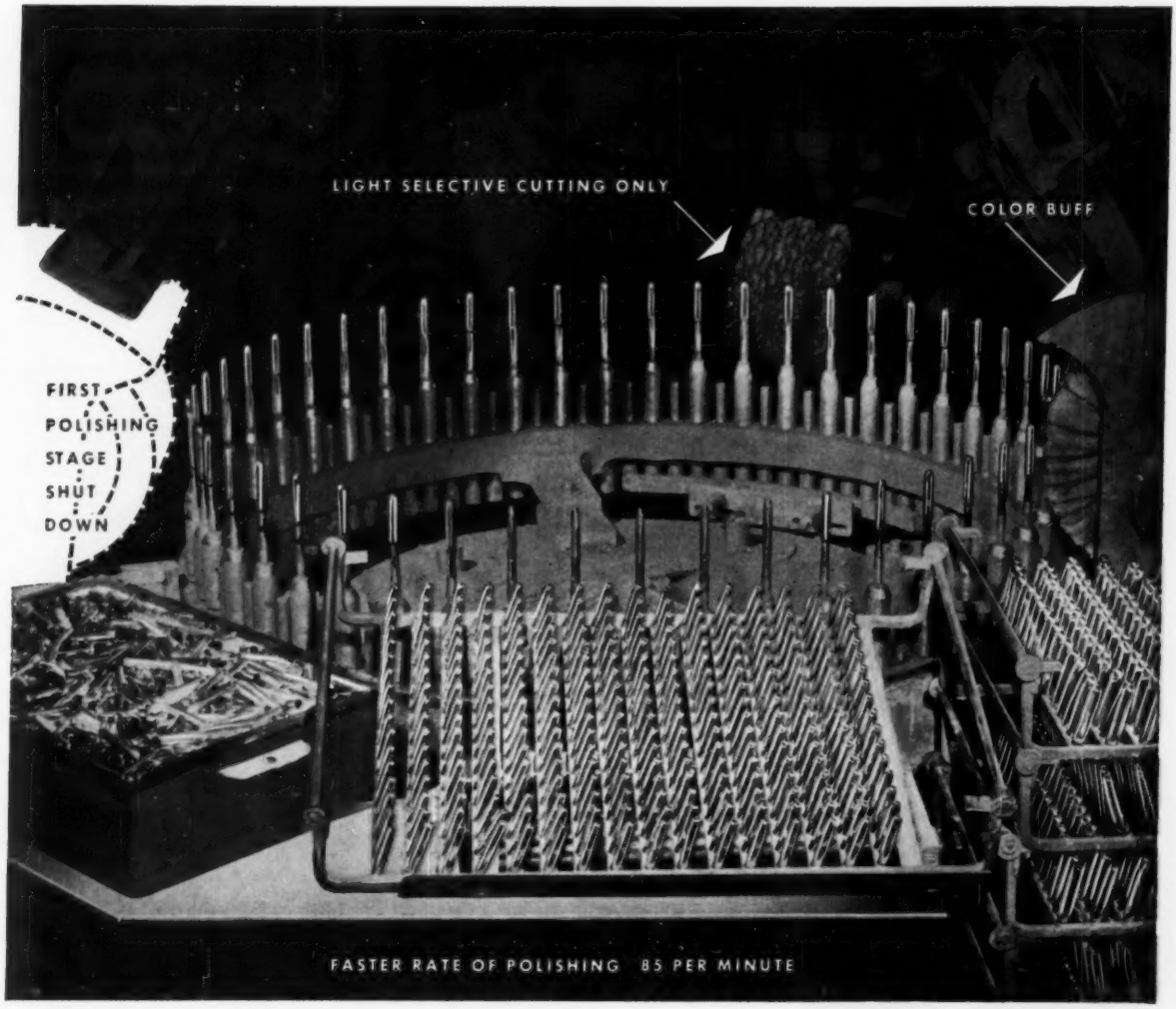
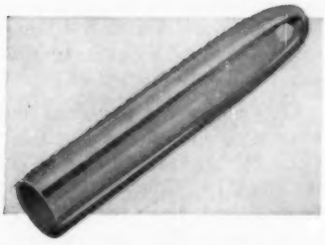


How Formbrite cuts polishing costs 40% for JARCO



Pens, pencils, and lipstick cases have to be attractive to sell—yet they must be able to take a beating in daily use. The Jarco Metal Products Co., which specializes in drawing metal parts for these and such other products as miniature flashlight cases, and similarly formed products, tried Formbrite,® Anaconda's new drawing brass, shortly after it was announced to the trade.

Superior polishing characteristics combined with excellent drawing properties, plus hardness and scratch resistance, sounded ideal for Jarco products. Formbrite has proved an excellent pressroom material. The uniformity of temper from batch to batch eliminated shutdowns for adjustments in their battery of 12-plunger Waterbury-Farrel presses, which can produce up to 500,000 pieces a day.

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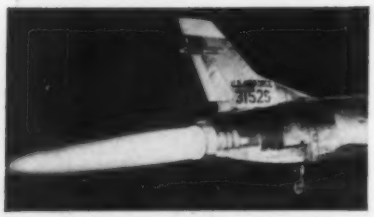

When heat's on. Few metals match Inconel nickel-chromium alloy in its resistance to high temperatures. In a jet plane flame tube, Inconel retains stability despite white heat.

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Volume 78 • Number 6

JUNE 1956

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Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Streets, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York 18, N. Y. Cable address, "Dynamic," New York. Price to members annually $3.50, single copy 50 cents, to nonmembers annually $7.00, single copy 75 cents. Add $1.50 for postage to all countries outside the United States, Canada, and the Pan-American Union. Changes of address must be received at Society headquarters seven weeks before they are to be effective on the mailing list. Please send old as well as new address... By-Laws: The Society shall not be responsible for statements or opinions advanced in papers or ...printed in its publications (B13, Par. 4)....Entered as second-class matter at the Post Office at Easton, Pa., under the Act of March 3, 1879....Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921....©Copyrighted, 1956, by The American Society of Mechanical Engineers. Member of the Audit Bureau of Circulation. Reprints from this publication may be made on condition that full credit be given MECHANICAL ENGINEERING and the author and that date of publication be stated.

MECHANICAL ENGINEERING is indexed by the Engineering Index, Inc.

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World's largest reversible pump turbine...

. . . goes into full operation at TVA's Hiwassee Dam in southwestern North Carolina. Shown here is the 330-in-diam rotor during erection. An equalizing bar with pointer keeps rotor level to assure equal distribution of its 305-ton weight on the two points of the gantry crane. The pump-turbine unit was designed and built by Allis-Chalmers Manufacturing Company, Milwaukee, Wis. For further details see pages 541–542 in this issue.

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JUNE 1956

MECHANICAL ENGINEERING

George A. Stetson, *Editor*

Promises to Men of Promise

JUNE IS THE month of academic ceremonies and commencement-day oratory. All over the land thousands of young people will stand in well-ordered ranks taking leave of Alma Mater, listening to the words which acknowledge their successful completion of the requirements for a degree and to high ideals and a call to future service — promises to men of promise. Black robes of academic costume will conceal all but the most striking physical characteristics of each individual. To a stranger each graduate is a man of promise, as much like his fellow as one seed is like another. But to their teachers, parents, and friends this uniformity does not exist. To them each graduate is an individual. In the atmosphere of ritual and oratory, teacher and parent alike will be moved by renewed hopes for the future and find comfort in thinking, This young man will succeed where I have failed. Through him I shall partially pay to the future the debt I owe to the past. In his life I shall find justification of my own.

Who hears or long remembers the words of a commencement orator? The officials who have frayed their nerves during long weeks of planning? The cynic who has witnessed too many such occasions and learned from none? The nostalgic old grad who has stolen a few hours from a busy life to renew the dreams of youth only to find that youth has passed him by? The parents who have sacrificed so much, planned so wisely, encouraged and admonished so many times, and who hope so fondly? The young people themselves, each filled with countless immediate plans and projects, eager to begin a new way of life but a little uneasy, perhaps, over the responsibilities that can no longer be shifted to school or home authority?

The fact that few hear or remember the words of a commencement orator detract little from the occasion of which they are a part. For commencement is the season of promise—the promise that is latent in the young person at the beginning of his career and the promises held out to him by those who accept him as a responsible adult. For a young man fully to develop the promise latent within him, the promises made to him must be kept. Thus commencement is not only significant to the graduate; it is significant also to the profession he enters and the organizations which employ him. So, perhaps, those who should give greatest heed to commencement addresses are not so much the students who are receiving degrees but their elders on whose behalf the orator states the ideals, inspires response to them, and bids welcome to the serious business of carrying forward the work and progress of human society.

In a message to ASME Student Members under the title "What of Tomorrow?" printed in the May issue, J. W. Barker, president of The American Society of Mechanical Engineers, presented what might serve as a commencement address. The fact that the message is addressed to Student Members does not relieve other members of the responsibility of reading it. Dr. Barker not only gives Student Members some sound and inspiring advice on how to develop the promise of achievement latent within each one of them, but he also promises benefits and satisfactions on behalf of the engineering profession and, more particularly, the ASME. Younger engineers can still profit from Dr. Barker's advice to the Students. But the older members have the responsibility of seeing to it that ASME lives up to the implied promises made to the young man.

Another document which should be read by young and old alike in the engineering profession is the EJC report on Professional Standards and Employment Conditions, printed in this issue. It, too, deals with promises, real and implied, and was prepared in recognition of a need "for the engineering profession to state clearly the employment conditions that engineers expect as professional men," and states, "Employers should align their policies with respect to the engagement of engineering personnel to meet these expectations."

The report recommends: That management utilize the services of engineers more effectively and thereby afford them the opportunity for advancement and economic improvement; that management recognize its responsibility to make engineers feel that they are a part of management; that management survey areas of communication, recognition, and salaries and, where found wanting, correct to conform with standards of professional practice; that the engineer take inventory of his services and his actions to make sure that he has a professional attitude toward his work; that engineering societies establish and employ appropriate means to maintain high standards of ethical conduct for professional achievement; that engineering societies encourage the professional development of their members and promote proper recognition of the profession; and that engineering educators emphasize the characteristics of the profession.

Were these recommendations to be put into effect, we should better fulfill promises to men of promise.

You and the Engineering Shortage

By Joseph W. Barker

President, The American Society of Mechanical Engineers

There are three things that are as sure as anything can be in our economic and social future:

1 Automation is going to find increasing application in the productive and distributive functions of our economy.

2 Automation will not cause widespread unemployment, but threatens instead to create a severe scarcity of certain kinds of labor. It will result in a decreased demand for unskilled labor but at the same time will more than offset this by a greatly increased demand for skills of many kinds.

3 We are going to have to move quickly to do something about the severe shortage of engineers and scientists that is already upon us, if the free world is to maintain its strength.

SOME journalists say that we have embarked on a Second Industrial Revolution. Whether or not this is an accurate term, it is certainly peaceful for a revolution. And what we are seeing today is not so new as some people might think. We have had the principles of automation ever since the early days of the republic. We have had feedback mechanisms at least as far back as James Watt and his flyball governor, invented in 1788.

What is different is that we are now applying these principles on a scale vastly larger than any we would have thought possible a generation ago.

Automation—on the Increase

Take the first point, for example—the significant thing to remember about automation is not that it saves time, or that it cuts the labor force, but that it makes possible certain operations that would be impossible otherwise. There is an excellent series of articles from *Scientific American*, published recently in book form under the title, "Automatic Control." One of those articles described what is probably the most highly automated plant in the world, a petroleum refinery where there are only two men in attendance—one to look after the central control panel, and the other one to be on hand in case the first one falls asleep, becomes ill, or dies. In commenting on this installation, the editors say:

"Modern refineries and chemical plants must be placed under automatic control because they are built to carry on processes that are too complex, too fast and too dangerous for control by human beings except through the mediation of robots."

Perhaps the classic example of the meaning of automatic controls is the almost universal application of dial telephones in America. Many people predicted that automatic dialing would put large numbers of telephone operators out of work. What happened is that there are many more operators than ever, and that more people have telephones, and are making more use of those telephones than ever before. In fact, it staggers the imagination to think what would happen if we had to use the old operator-controlled system to take care of all the people who seem to want to talk to one another. It would simply be impossible.

There is no question that automation will eventually create more jobs than it displaces. That does not mean that we should be callous to the impact of temporary displacement because of technological advance. Norbert Wiener, in his new autobiography, tells of his first reaction when he began reflecting on the relation between the high-speed computing machine and the automatic factory.

"I wondered," he writes, "whether I had not got into a moral situation in which my first duty might be to speak to others concerning material which could be socially harmful. The automatic factory could not fail to raise new social problems concerning employment, and I was not sure that I had the answers. A vast redistribution of labor at different levels would be created. When the human being is used mechanically, simply as an inferior sort of switching or decision device, the automatic factory threatens to replace him completely by mechanical agencies. On the other hand, it creates a new demand for the highly skilled professional man who can organize the order of operations which will best serve a particular function."

While there is no doubt of Dr. Wiener's sincere concern on these issues, they do create mixed reactions. It is agreed that the spread of automation will create a new demand for the highly skilled professional men. But it is disagreed that the human being is an inferior sort of switching or decision device. The idea of man as the maker of decisions, operating from free will, is, after all, based on the divine concept of humanity. Certainly, no man is degraded by sitting at a control panel using his brain and his power of decision instead of carrying a load on his back.

In the same book Dr. Wiener tells how he participated in a symposium on the automatic factory sponsored by The American Society of Mechanical Engineers. He compares his reception from ASME with one he had got three years earlier from another group, and he says:

"The progress in the general attitude from the first talk to the second was remarkable . . . The social consciousness of the group as a whole was far beyond what I had found three years before. While there were a good many who were more sanguine than I had been as to the

Based on an address delivered at the President's Luncheon during the Spring Meeting, Portland, Ore., March 18–21, 1956, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

possibility of achieving a large measure of industrial automation without catastrophe, there was a general awareness of the interest of the public at large in a meeting which was going to affect so profoundly their future method of life."

One thing we can all be sure of: There is no turning back. Automation is here to stay, and the businessman who ignores that fact is going to find himself trailing the competition—just as the nation that ignores it is going to find itself in extreme jeopardy, both economic and military. Whatever social problems are created by automation are going to be solved not by trying to hold back the tide, but by trying to control it and by building up safeguards to withstand it.

Automation to Create Jobs

The second point is that automation, far from destroying jobs, is going to create a severe scarcity of certain kinds of labor. This trend is already under way. The aircraft industry, for example, used to employ engineers in a ratio of about one to every 20 employees. Today the ratio is something like one to eight, and the trend is continuing in that direction.

The same picture is to be found in other industries. It is a historical fact that the machine designer is always a step ahead of the operator. Roger Burlingame, in the book, "Machines That Built America," points out that Eli Whitney nearly had to abandon the cotton gin because he could not find enough skilled workers to build that simple machine in sufficient quantity to make it profitable.

"Machine production began in the United States," he says, "not because there were so many mechanically skilled people, but because there were so few."

Today we have a vast supply of skilled labor. On the other hand, industry's biggest problem today is not production or distribution; it is cost. That is the word you hear most often in the conference rooms. And the answer to the problem of costs lies in new and improved methods of continuous production, which call, in turn, for a greater supply of skilled technicians. There will be a booming job market for these skilled technicians for many years to come.

Supply of Engineers and Scientists

The third point is that we are going to be in serious trouble unless we do something immediately about the shortage that we already have in our supply of engineers and scientists.

Some people tend to express this shortage in terms of the difference between the rates at which we and the Russians are training people. That is an important index, but it should be remembered that we have an absolute shortage of more than 50,000 engineers and scientists to fit into our peacetime economy. Last year we graduated 4000 fewer engineers and scientists that we needed just to replace the number of industrially employed scientists and engineers who retired or died. We would be in trouble even if we had an ironclad guarantee of peace for the next decade.

Unfortunately, we have no such guarantee, and so the shortage has military-political significance, as well as economic. Over the past 25 years the Russians have turned out about three engineers for every two of ours. Last year the ratio was about two to one. In addition to these specialists, the Russians are training a vast army of second-line technicians. What is more, they are feeding their people into the giant digestive system of Soviet economics that takes in heart and brain and converts them into bone and muscle.

We have recently witnessed a great debate—it is not over yet—on the pace of our guided-missile program, with much conjecture as to whether we are falling behind the communists in this area. Whatever the answer, we are not going to increase our rate of progress merely by means of stepped-up appropriations. The greatest scarcity is in the supply of that rare commodity, the trained and creative mind. That is a scarcity that cannot be solved overnight, by Congressional action.

What is causing this problem? It probably begins in elementary schools and comes to a head in high schools, where the young student decides what he wants to be and begins electing subjects to prepare for his future.

In part, the difficulty is the result of a statistical impasse. Just about all children of school age today were born in the 1940's, when, for the first time in the history of America, rate of population growth showed a sharp upturn—twice as high as in the previous decade.

To teach our children, we are relying in large part on the generation of the 1930's, when the net increase in United States population was smaller than that of any decade since the 1860's, and the smallest in our history in terms of percentage. One doesn't have to be much of a statistician to see that the problem threatens to get considerably worse before it gets any better.

Not only do we have more children around today—more of them are going to school, for more years, than ever before. In 1900 only 11 per cent of the children in the 14-to-17 age bracket went to high school. Today the figure is 80 per cent. In the 18-to-21 age group, the percentage of college students rose from 4 per cent to nearly 30 per cent.

Shortage of Teachers

These young people do not have as many teachers as they should have. Often, their teachers are not as good as they should be. Worst of all, students in the high schools are not taking the courses that are designed to equip them for life in our changing society. They are electing courses that will get them through school with a minimum of intellectual nourishment, just as certain people of Asia eat mud and get a comfortable feeling in the stomach, but not much in the way of nutrition. Dorothy Thompson, in a recent column, pointed out that only 4 per cent of American high-school students are studying elementary physics, 7 per cent chemistry, 27 per cent algebra, and 13 per cent geometry, and that half our high schools do not even offer courses in chemistry and physics.

The Fund for the Advancement of Education has predicted that between now and 1970 we will have to find 16 to 25 new college teachers for every 10 now employed. They say that in order to fill our teaching needs we would need half of all the college graduates for the next 10 years. Obviously, we are not going to get them.

What is the answer? There is no single answer. Above all, it is emphasized that there is no national answer to this problem. It is going to have to be worked out locally, in community after community across the nation. Maybe this is an impossible assignment. But work has already begun, and we are seeing what can be

done when clear thinking and sincere effort are applied.

For example, Bay City, Mich., like many other American communities, had a school problem. A study was instituted, with the help of Central Michigan College. They found that the teacher's traditional complaint of vast amounts of unnecessary work was justified.

They found that each of their 137 teachers was spending from an hour and a quarter to more than four hours every day on a combination of activities, which did not require professional teaching competence and could be included in the general phase housekeeping.

What did they do about it? They instituted a system for the use of teacher aides. These teacher aides took roll call, checked papers, recorded grades, prepared materials for teaching, gave first aid, supervised home rooms—all the dozens of things that take so much of the teacher's time without requiring any of the teacher's special talents.

What was the result? They found that the new system made it possible for the teacher to spend an average of 23 per cent more time on activities closely related to instruction. She spent 20 per cent more time making assignments. Recitation time increased over one full hour per day. Teachers spent 41 per cent more time in supervision.

They polled the parents and found that 100 per cent of them felt their children were enjoying school more, and 83 per cent felt that their children were learning more, while the other 17 per cent thought they were learning at least as much. All of the parents wanted the program continued. Of the pupils, 94 per cent said they liked the plan, and 98 per cent said they would want to be in a room with a teacher aide the following year. Probably the small remainder consisted of those who resented the fact that the teacher had 20 per cent more time to make assignments.

The plan had another happy consequence: Many of the original aides enrolled in programs intended to prepare them to become full-fledged teachers.

That is one solution. It is not a complete solution, and it may not be the best solution for your schools. In Ohio there were three high schools that were worried about the caliber of instruction in science courses. They, too, hired teacher aides. In addition, they hired three topnotch instructors, one in physics, chemistry, and mathematics. These three moved from school to school, like circuit riders, giving each school a level of competence in those three courses that it could not have afforded on its own. It should be remembered that, of America's 28,000 high schools, 22,000 have fewer than 500 students. Obviously, the smaller schools cannot all afford to hire top-quality teachers for every course. Maybe the answer lies in pooling parts of their faculties.

Another place where local businessmen have given a major assist to the schools is in the area along the Niagara River, in western New York. Industries in that area have set up refresher courses for high-school science teachers. These classes are conducted at a single center. Teachers are given mileage allowances for transportation, and they get credit from the State Department of Education for their work. The companies are happy to co-operate because it means better instruction in high schools, and even if students do not go on to college, they are going to be better workers because of that instruction.

In some areas, it might be practical to have engineers volunteer to devote, say, three hours a week to teach one class in mathematics or science. In addition, we have an increasing reservoir of engineers and scientists who have passed the mandatory retirement ages for their companies but who are capable of many years of community service as teachers. Whatever legal barriers keep them out of the classroom should be removed.

Teacher Pay—a Problem

Teacher pay is certainly an obstacle. What happens when a high-school science teacher sees a newspaper ad offering $400–$450 a month for a new engineering graduate, and compares it with his own $250 or $300 a month? What often happens is that he gives notice, and that is not good for his pupils, his school, or the nation as a whole. Taking the long-range view, it is not even good for the company that hires him away.

The president of the University of Delaware has told of the case of one of his seniors who had planned to become a high-school science teacher, but was hired by a large corporation at a salary of almost $6000 a year. That was more than he could ever earn in the public schools of Delaware, under the existing scale. It was $1000 more than they were paying to assistant professors at his own school, and it was almost as much as they paid to associate professors with PhD degrees and years of experience behind them.

It seems one of the paradoxes of our economic system that we pay all our teachers according to the same yardstick. It is admitted that it would create certain personnel difficulties if you paid more to a teacher of chemistry than you did to a teacher of French. The simple truth, though, is that industry is not offering large salaries to teachers of French. We should realize that the educational system of the nation is not immune to the laws of supply and demand. We will have to abandon the "lock-step" pattern of teacher pay if the schools are to compete successfully with private firms for instructors in mathematics and the sciences.

Study of Engineering Urged

Another thing we must do is to get word to the vocational counselors that the study of engineering is a good thing. One of the reasons for the present shortage is that these same counselors, during and immediately after World War II, took to heart the predictions that we would not be able to convert to peacetime production without a serious depression, and that there would be a glut of scientists and engineers.

Well, they were wrong, and so were the planners whose advice they took. Some of the counselors, though, may not yet have realized their error. They may not have heard that there are some 5000 firms today that have recruiting teams in the field looking over the approximately 350,000 students who will get bachelor's or master's degrees this year, and that the demand for engineers is higher than it has ever been. They may not have heard about the school that reports 12 to 15 job offers for each of its engineering seniors.

You should tell them. You should tell them that Standard Oil Company of Indiana has assigned 15 of its topflight research people to go around the country seeking out engineers and technicians, that General Electric Company is looking for 2000 technicians, that General Motors is looking for 900 engineers, that pay is at an all-time high, and that the number and variety of opportunities is greater than ever. In short, there never was a time when it made so much sense to prepare yourself to become an engineer.

Firsthand Observations on

Materials Handling in the Soviet Union

By W. H. Brandt, Member ASME

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Westinghouse Electric Corporation
East Pittsburgh, Pa.

In December, 1955, a team consisting of N. L. Bean of the Ford Motor Company, Dr. A. C. Hall of Bendix Aviation Corporation, and the author visited the Soviet Union to study automation. The team, chosen by ASME at the request of the State Department, spent two weeks in the Soviet Union. During this time they visited seven factories and four research institutes. Most of these were in the Moscow area, but trips were taken to Gorki, Stalingrad, and Leningrad, so that time for each visit was rather limited. In most cases, one to two hours were spent in touring the factory or laboratory and one or two hours were spent in discussions with the director and engineering personnel. The Russians were hospitable and anxious to talk about automation. They also showed some basic know-how in materials handling. Best efforts seemed to be concentrated at those points where they were going all-out for automation. This has caused them to neglect improvements in relatively modest engineering effort which should pay handsome returns. In some places they will doubtlessly have to step up rates of production tremendously in order to achieve present-day American standards. It must be remembered, however, that no military factories were visited. It is not unlikely that in the military factories they have much more modern industrial equipment of all sorts.

THE engineers of the USSR have not, in their thinking, isolated materials handling from other problems of industrial equipment to the same extent that it has been done in the United States. They have aggressive automation programs under way and show good materials handling in those cases where this was required in connection with setting up a highly automated line.

In those places, however, where materials handling is not intimately connected with highly automated production, it has not had the attention that it deserves. Nearly every factory has in it many cases where very modest investment in materials handling should result in great improvements in efficiency.

Contributed by the Materials Handling Division for presentation at the Semi-Annual Meeting, Cleveland, Ohio, June 17–21, 1956, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Automation Program

The Russians are working intensively on automation in research institutes and development institutes. In the research institutes they consider their problems quite basically. For example, they have extensive programs set up for the study of telemetering or information handling as it affects or may affect industrial processes. Usually the approach here is theoretical with enough laboratory experimentation to verify the theory. This type of effort will bear fruit ultimately in improved automation in the factories. No evidence was seen of the same sort of basic thinking on materials-handling problems.

The development institutes concern themselves with advanced designs as will be required over a period of approximately the next five years. The particular development institute that we visited was the Experimental Scientific Research Institute for Metal Cutting Machine Tools. Most of the work going on in this particular institute concerns design of the machine tool itself including hydraulic control systems, pneumatic control systems, and to some extent electrical control systems. They engage in materials-handling effort in this institute only when they connect two or more machine tools with automatic handling devices. It is obvious that they are giving thought to materials handling in designing many of their new machines.

Fig. 1 shows an automatic balancing machine that is

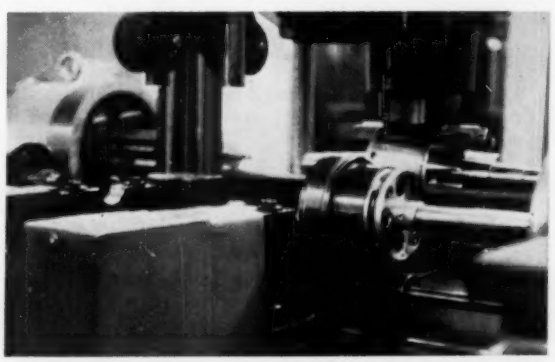

Fig. 1 Balancing machine under development at Experimental Scientific Research Institute for Metal Cutting Machine Tools. Obviously, this machine can be used in an automatic line.

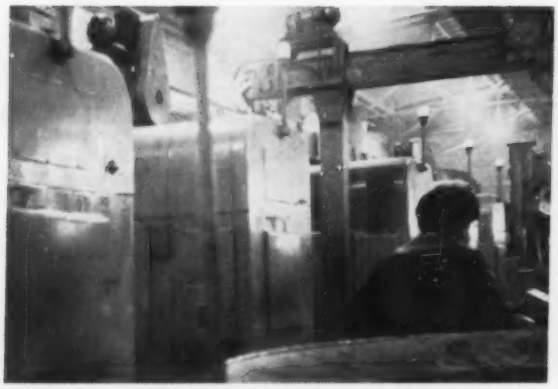

Fig. 2 Beginning of bearing assembly line—State Ball Bearing Plant. Rough forgings are placed in hopper *at right* and are automatically conveyed to chucker lathe *at left.*

Fig. 4 Gravity conveyer—automatic bearing line—State Ball Bearing Plant. Note races in the conveyer. Heavy construction is often used.

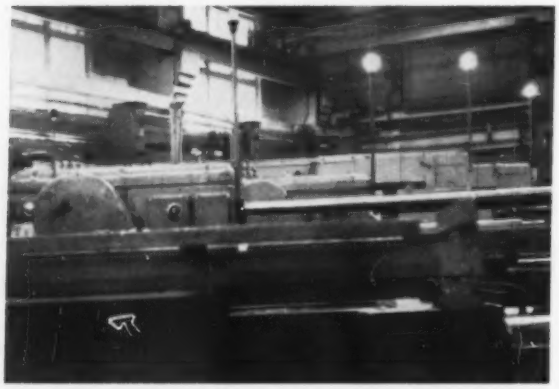

Fig. 3 Arrangement of machines on automatic line—State Ball Bearing Plant. Note crane, *upper right.*

under development. It spins the rotor of an electric motor, records the magnitude and position of unbalance in a memory, and moves it to another location where drills automatically remove the required amount of metal to put it in balance. Since it is still in the experimental stages it requires an operator at the present time. It is also clear that when complete the machine can easily be set into an automatic line.

Ball-Bearing Assembly Line

This institute designed an automatic assembly line for bearings that was the best example of automation in materials handling seen in the Soviet Union. It is located at the Kaganovich State Ball Bearing Plant No. 1 in Moscow. Here race forgings are placed in a hopper, lower right, Fig. 2, and are automatically conveyed from the hopper to the chucking lathes shown at left in the picture. Each lathe does four operations and moves part to next line. Scrap is fed by chute to an underfloor conveyer servicing all lathes. Its position is between the lathes and hopper. All handling to the point of final delivery of a packaged bearing is completely automatic, Figs. 3, 4, 5, and 6. Gravity conveyers, chain conveyers, and pusher conveyers are all used. Chips from the lathes pass through chutes to a chain conveyer in the floor. Chips are controlled to a maximum length of about $^1/_2$ in. It was particularly interesting to see good chip control on this automatic line because in many other locations turning operations produced long spirals very difficult to handle. Apparently chip control is somewhat like the problem of materials handling, in that Russians know how to solve it and do so on a fully automated line. In other cases the problem gets little attention.

Intermediate Storage. A particularly noteworthy feature of this line is the use of storage at intermediate points. At these points as many as 1000 parts may be stored to balance production rates in various machines and to provide continuity of operation in case of unexpected machine breakdown. There are automatic inspection stations such as shown in Fig. 5 at various points along the line. These inspection stations merely reject unsatisfactory parts. The line had been in operation for approximately three months. Rejects were running at 1.6 per cent in December, 1955, and it was stated by the engineers that this was because some of the machines were not yet performing up to expected standards.

It is an interesting feature that there is no feedback on this line. It is believed that they have worked out elaborate schedules of tool replacement and tool adjustment and by this means avoid the necessity of adjusting tools by feedback. Only one operator on the line could be identified as performing an operation in connection with the over-all assembly. However, there were numerous maintenance men in attendance. This renders an actual count of productive men rather uncertain.

Quality Standards. While it is difficult to evaluate the quality standards of this assembly line, there seems to be little doubt that the materials-handling problems have been solved satisfactorily. The Russians do not lack materials-handling know-how, though they seem to be unwilling or unable to apply this know-how except where they go all-out for automatic operation.

Lathe Assembly Line

Another quite impressive manufacturing operation is at the Red Proletariat Machine Tool Plant. It is a lathe assembly line having a capacity of 54 lathes per day. While not so highly automatic as the bearing line, it is unusual in its capacity and illustrates the willingness of

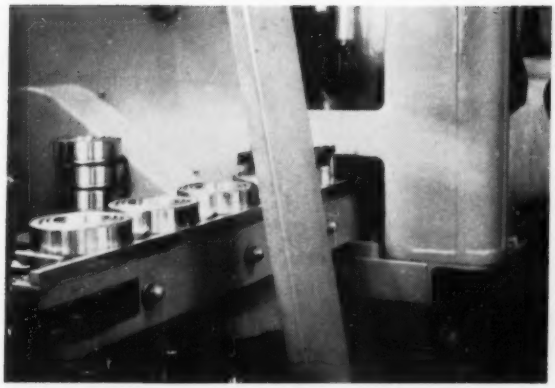

Fig. 5 Chain conveyer to the final inspection station—automatic assembly line—State Ball Bearing Plant. These inspection stations merely reject unsatisfactory parts.

Fig. 6 Packaging machine delivering packaged bearing—State Ball Bearing Plant. All handling to the point of final packaging is completely automatic.

the Russians to standardize designs for the sake of getting higher output of machine tools.

In Fig. 7 the line moves away from the viewer. The line itself consists of a plate-type conveyer which is normally below the surface of the floor. When movement of the line is required, the conveyer is raised above floor level, picks up each lathe, moves forward one position, is then retracted below floor level and returned to its previous position. This motion is under the control of a foreman.

Subassemblies are manufactured in an aisle to the right and move from right to left to the line by means of monorail hoists. It might be remarked that 54 identical lathes per day is a rather large number. It was noted that the Russians often use general-purpose machines where special-purpose machines would do a better job. It is possible that the Russians have gone beyond the point of optimum return in standardizing machine tools. This assembly line in the Red Proletariat Plant was by far the best operation in the plant. For example, in the plant we saw induction heat-treating done in which the operator held a part by one end while the other end was being heated.

Automobile Production

The Gorki Automobile Plant produces trucks, jeep-like vehicles, passenger cars, bicycles, and toys. About 12 per cent of the vehicles produced are passenger automobiles. Two models of passenger cars are manufactured, the Pobyetta (or Victory) and the Zim. The Pobyetta assembly line is shown in Fig. 8. The frame of this car is integral with the body and this fact is probably related to the unusual feature that initial assembly is done with the car in an overhead position so that workmen may move and work under it freely. In viewing these Russian assembly lines, one has a feeling that a certain amount of "staging" may have been done for the benefit of the visitors. For example, note that on the Pobyetta assembly line there is no evidence of materials' being transported to the line.

A view of the same room from the opposite end is shown in Fig. 9 with a 4-wheel drive Pobyetta in the foreground. When all operations are finished in the overhead position, the car is picked up and set on another line in which it proceeds at about waist level for a number of stations. It then goes down a ramp and the as-

Fig. 7 Lathe assembly line at Red Proletariat Machine Tool Plant. Line moves away from viewer. Subassemblies are made in an aisle *at right* and are moved from right to left with individual trolley hoists visible in the picture. The line itself consists of a conveyer which rises above floor level, moves forward one position, retracts below floor level, and returns.

Fig. 8 Pobyetta assembly line. Line moves counterclockwise as viewed in picture. Axles are placed on stands *at left,* bodies lowered on them, and workmen work under the cars. Note tile floors and generally good housekeeping.

Fig. 9 Pobyetta car photographed at opposite end of same aisle as shown in Fig. 8. This model is a 4-wheel drive—required 9 in. greater height from ground. Note provisions for overhead hoists.

sembly is completed at floor level. A lifting rack with hooks is provided for transferring the car from the overhead position and this may be seen in Fig. 9, upper left.

The capacity of this line is 150 cars per day. It was not operating at capacity on the day the visit was made. Note the tile floors and generally good housekeeping in this area.

Subassembly lines generally show fairly good housekeeping though they are usually slightly inferior to the main assembly line in this respect. Figs. 10 and 11 show the Zim body line and an engine assembly line in the Gorki Plant. Chain conveyers are used on such lines and seem to be under the control of a foreman.

Productivity

It was felt that in most Soviet plants productivity per man-hour is probably less than half that in a corresponding American plant. In the case of the Gorki Plant, a rough estimate may be made of productivity in terms of the length of time a man must work in order to pay for the plant product. A Pobyetta costs 20,000 rubles, or $5000. It would cost the average Russian worker about 20 months' salary to buy one. The average American worker can probably buy a $2000 automobile for about 6 months' salary. The ratio is roughly 3:1, taking no account of the fact that the American automobile is larger and better in nearly all respects.

In those sections of the factory where parts are being manufactured, housekeeping is much poorer and it is here that materials handling could easily be greatly improved. In Fig. 12 the use of two workers to convey a part to a belt conveyer seems wasteful of labor. The hand trucks and large tote boxes in Fig. 13 do not appear to be well adapted to handling of small parts. In these areas, lighting, ventilation, and heating are much poorer than in the area of the assembly lines. The workers do not seem to mind the relatively low temperatures. They dress accordingly, but it is hard to see how good safety records can be maintained under the lighting conditions in many places.

It is difficult to generalize even on the cases of materials handling that are obviously below the standards of a good American factory. One must remember that 120 passenger cars per day is a very low rate of production, and that perhaps a machine to perform the operation shown in Fig. 12 would operate for a small percentage of the time so that even a modest investment would not be worth while. Almost certainly, however, this does not apply to all poor materials handling that was seen.

There are few fork trucks or lift trucks seen in the Soviet Union—instead, one sees large tote boxes handled by cranes. Sometimes hand trucks are used and very often one sees motor trucks (usually similar to a Model A in appearance) pulling one or more tow wagons.

Effect of War

In evaluating Soviet industry it is only fair to take into account certain special problems that arise in their factories. The city of Stalingrad was, of course, completely wiped out during the war and this has created numerous difficulties in getting the Stalingrad Tractor Plant into satisfactory operation. The factory itself was completely ravaged as the Russo-German lines ran directly through it at the last and hardest stage of the battle. The tractor plant is still considered by the management to be in the process of reconstruction.

There are still substantial areas of Stalingrad not rebuilt, though enough housing of sorts has been provided for everyone.

It is probably only fair to state that considering the

Fig. 10 Zim body line at the Gorki Plant. Conveyers are of chain type. Hand tools are used extensively.

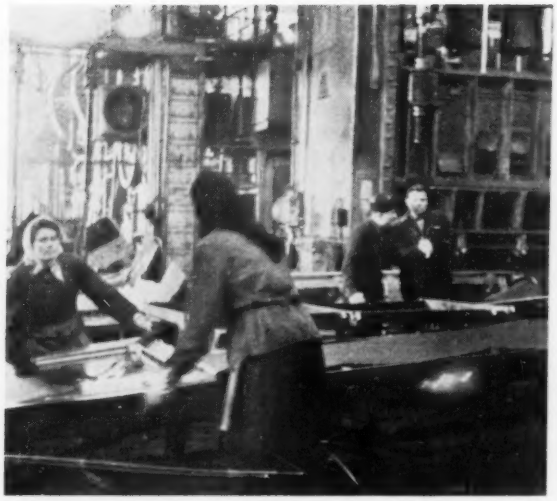

Fig. 12 Conveyers of semifinished part to belt conveyer—Gorki Plant. Part comes from a press out of picture to left.

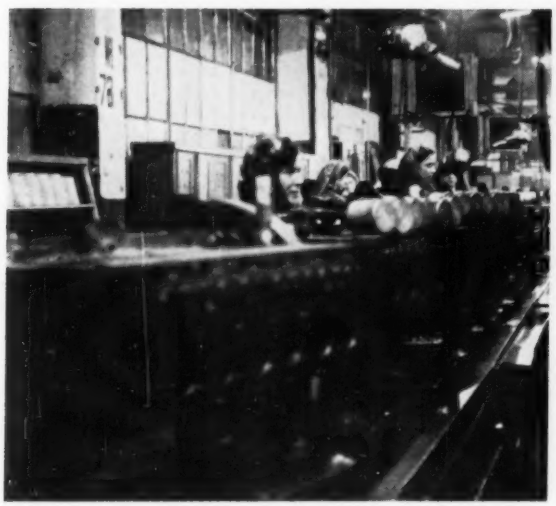

Fig. 11 Engine assembly line—Gorki Plant. Chain conveyers are used on the line. Note that housekeeping and cleanliness are fair.

Fig. 13 Typical view of punch press plant—Gorki Plant. Tote boxes are large considering size of parts and usually are handled by crane.

problems of rebuilding the city, the general operation of the Stalingrad Plant must be rated as quite good. It is operating at the present time at about 75 tractors per day. One of the tractors produced may be seen in Fig. 14.

Materials Handling at Stalingrad Plant

No pictures were allowed in the factory itself. The plant has its own steel foundry and in this area lighting, ventilation, air cleaning, and materials handling were poor. Some chain and roller conveyers are in use in the foundry but there is much transfer of rough castings and other material by hand trucks and wagons towed by motor-driven trucks.

There is one transfer machine in operation on cylinder blocks in the main plant. The assembly line is fairly good, though not all stations are occupied. The plant, over-all, does not give the impression of a plant rebuilt since the war. Visitors returning from other parts of Europe report that many industries have taken advantage of war damage to build a new modern plant. This was not done in Stalingrad. For the most part one has the impression that they merely rebuilt what they had before the war.

Dam and Subway Construction

A new dam is under construction on the Volga near Stalingrad. At this site it is planned to develop 1,700,000

Fig. 14 Tractor made at Stalingrad Tractor Plant. Only track-type tractors were in production at the time the plant was visited.

Fig. 16 New Leningrad subway. There are eight stations on this line. Each is of a distinct type of architecture and different color marble.

Fig. 15 Cable conveyers at site of New Volga Dam. View in picture is almost directly away from the dam.

Fig. 17 Truck, snow plow, and cinder spreader shown spreading cinders on the Campus of the University of Moscow

kw with transmission lines to Moscow operating at 400,000 volts. A cableway used in this construction project may be seen in Fig. 15. Conditions were too foggy to permit a view of the dam under construction. No large earth-moving machines were seen here or at any other location visited.

Our team rode on the new Leningrad subway, Fig. 16, and to the best of our knowledge we were the first visiting Americans to see this subway. There are eight stations; each of them has a distinctly different style of architecture with a different color marble. The cars do not run at high speed, but are comfortable. The subways are very deep and it is claimed that the electric stairways leading to the stations are the longest in the world. The length was estimated to be about 250 ft with a rise of about 100 ft.

Handling Bulk Materials

The Russians have one bulk materials-handling problem which comes to the attention of every winter visitor—that of snow removal. Most of the workers at this task are still women dressed in quilted clothing who scrape and sweep the snow into piles. However, they do have mechanical loaders that move in and load the snow on trucks which take it away. These loaders seem of somewhat crude design, but they appear to work satisfactorily. They also have snow plows as well as cinder spreaders, though apparently not in large quantity as yet.

Fig. 17 shows a truck spreading cinders on the campus of the University of Moscow.

Contrast in Systems

The status of materials handling illustrates the difference between the socialist system of the USSR and the capitalist system of the U. S. A. In Russia, problems get solved if they are big enough to come under the eye of planners in Moscow. Many small problems get neglected. In the U. S. A. problems get solved if some one can make money by solving them. This catches the big ones and many small ones too. In Russia, materials handling is a problem; in the U. S. A., it is a business.

The advantage is on our side in providing a high standard of living for our people. This advantage is not nearly so marked in producing for war. Everyone must change to a planned economy in producing for war. The Russians know how to operate a planned economy. We must not be complacent about our ability to excel them in military production.

What Price the Professional Engineer?

Some of the problems involved in submitting contracts for engineering work

By James M. Todd, Past-President ASME

James M. Todd & Associates, New Orleans, La.

THERE is a total lack of professional consideration in competitive bidding for professional-engineering contracts.

To my personal knowledge—with over 25 years of private practice—in our area engineering services cost the client no more today than they did in 1930. Engineering services—unlike any other commodity—still go to the lowest bidder. And make no mistake, the cost of delivering professional-engineering services has increased—like all other services.

No Increase for the Engineer

As recently as the September, 1955, issue of MECHANICAL ENGINEERING (page 852) there is a news item which states, "Starting salaries for engineers continue to increase." Please do not misunderstand me—I am for that increase—because it all leads to a better economic position for the engineering profession. What I wish to emphasize is that the "professional engineer," with increasing costs for help—engineers, stenographers, blueprints, electric typewriters, or what have you—still has to work on the same depreciated-fee basis as existed 25 to 30 years ago.

Competitive bidding for professional work, in my opinion, is at least partially responsible for these conditions. We all admit that good engineering is the result of man's thinking power, and hence will vary somewhat in individuals. It is impossible to set up a standard of measurement that will fit in all cases. It follows, therefore, that any form of competitive bidding for an engineering assignment must necessarily penalize the better engineer, causing the client to suffer by the process.

Competitive Bidding

Business generally recognizes competitive price in most commercial transactions, with this stipulation, however, that the "competitive price" must be based upon similar or competitive articles. No intelligent purchasing agent would tolerate a competitive price on a dissimilar article. The same individual or company, however, will accept a competitive price for engineering services without in any way making an effort to evaluate those services against a more reliable, more experienced, more efficient, engineering organization. There is just no "specification" adequate to measure the variations in services of different professional engineers in a competitive bid. Practically, a potential client could properly give consideration to the anticipated fee and the expected services of various engineers in arriving at a decision; but these fees and services could not in any sense be considered competitive. They are, and by nature must be, very dissimilar commodities, and hence the price cannot be competitive.

This lack of professional consideration is evidenced both on the part of the practicing engineer and the client. The public or employers of professional practicing engineers do not yet know exactly what they do, how they do it, or more important for this discussion, what they should pay for professional services. This, no doubt, is due to the fact that so much engineering work is done, with the bare engineering fees hidden in contractors' profits, financing costs or architectural fees, on any given assignment.

On the other hand, we as professional men are too often tempted to "cut our fees" in order to secure an assignment and keep the boys busy.

The "Package Deal"

Many large firms seek projects in which they furnish plans, specifications, financing, and construction of the work—the so-called package deal. As these firms generally operate on the cost-plus or fixed-fee basis, all expenses—including engineering costs—automatically become part of the cost of the project. It has been my personal observation that clients pay substantially more for values received on this basis than if plans and specifications were drawn separately and competitive contract figures were secured before award of construction contracts.

In the case of plans, specifications, financing, and engineering—the package-type deal—the organization becomes both judge and jury of its own design and work. Even when these oganizations carry registered professional engineers on their staff, it is questionable, in my mind, as to whether or not the client gets the most for his money. Of course we must admit that he gets a firm figure for his completed project, but an adequate, all-inclusive, complete, carefully designed set of plans and specifications, based on full information from the client with competitive bidding for the construction contract, will definitely result in a cheaper cost for the same project.

Each of us in his field of practice has at least once come into contact with a project where the manufacturer or local representative of a manufacturer prepared the plans and specifications for a piece of work—and then bid upon his own equipments—turning down all proposed "or equal" suggestions to the owner or architect.

We hear a great deal these days about the "shortage of engineers." *Business Week* of July 30, 1955 (page 126) had a rather complete article on this subject. That article, however, did not bring out any information on a fact which we all know—that many graduate engineers leave the field of engineering for purely economic reasons. We have all known professional practitioners who have sought other fields because the fees paid for professional

Presented at the Technical Session of the Committee on Professional Practice of Consulting Engineering at the Diamond Jubilee Annual Meeting, Chicago, Ill., November 13–18, 1955, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

work were too low to take care adequately of the mounting expenses of maintaining an office. Many professional registered engineers—at least in my area of practice—still work out of their homes, keeping down office overhead and expense, so as to make both ends meet in a spiraling economy.

"Horse-Trading" Fees

Most professional engineers still work for the same horse-trading fee base as has existed for the past thirty years.

I believe that overemphasis on selling professional-engineering services will belittle the product and tend toward a lower fee base for a given project. I don't mean that a professional-engineering office should not attempt by sales procedure to obtain assignments, but I do think that too much sales effort, too much competitive bidding for work, keeps the fee for professional work to minimum values.

Charges for services rendered should be realistic, with adequate provision for all direct and indirect costs and allowance for a fair margin of profit, to insure best possible results for the client and the engineer's continued practice.

Through observations in my practice with contacts over a major portion of this country, the 6 per cent basic fee charged by architects has been always understood as standard for services of their kind, regardless generally of the project type or magnitude, except for residential work. With the development of air-conditioning, and heavier mechanical details in building construction, there has been relatively little resistance to an added 4 per cent to the architectural costs to cover these details. This is because the American Institute of Architects has publicized these details. The same owner, however, when dealing directly with a professional engineer, feels that he can get—and will generally ask for—a cut in professional-engineering fees for the same work.

Architects' Single-Fee Schedule

I believe the ready acceptance of the fees for architectural services has been brought about by the fact that a single-fee schedule has been publicized, rather than any complicated sliding scale of fees, as has generally been proposed by the engineering societies.

In today's building, the plan, specification, and supervisory costs for mechanical work, and in some cases the same costs for electrical work, are proportionately greater than those of the structural and the architectural work. Nevertheless, it is the average end result that counts. This is undoubtedly the answer to the large amount of work that is contracted at the 6 per cent basic fee, without surcharge for mechanical or electrical work, even though these phases of the project exceed the architectural costs.

Regardless of whether the architect is compensated additionally for engineering services performed in or out of his office, it is my firm opinion that the only professional manner in which such services can be rendered is on the basis of the fee that would apply in case such services were performed for the owner direct, with allowance of a discount, to cover the architect's development, co-ordination, and overhead service costs properly applicable. The architect is entitled to some profit on services subcontracted to professional engineers but, under such circumstances, certainly not the rate he now makes on his engineering associates or consultants.

Proposed Schedule for Engineers

The schedules of fees proposed by professional groups of various states and by our own membership have been reviewed with much interest, Table 1.

Table 1 Schedule of Fees Proposed by Professional-Engineering Groups

Construction cost of work	For simple engineering design, per cent	For complicated work involving detailed and difficult engineering design, per cent
$ 100,000	7.3	9.3
200,000	6.3	8.0
300,000	5.8	7.3
400,000	5.5	6.8
500,000	5.3	6.5
600,000	5.1	6.3
700,000	4.9	6.1
800,000	4.8	5.9
900,000	4.7	5.7
1,000,000	4.6	5.6
2,000,000	4.4	5.4
10,000,000	4.0	5.0

In no instance, however, has any basic figure been established for any particular class of work comparable to the architect's 6 per cent figure. Also, all schedules are involved with so many ifs, ands, and buts, that it's no wonder our group was never able to reach an agreement. Such complication also affords an easy means of misinterpretation, sometimes deliberate, to suit a particular purpose. It forces bidding for professional assignments by professional consulting engineers.

Minimum Basic Percentages. With the view of simplification and hope of minimizing possibility of juggling and, foremost, to place ourselves in a position that will be understood and command the respect of our clients, either owner or architect, it would be my recommendation that minimum basic percentage figures be established, as necessary to meet the requirements of the various branches of engineering involved, all predicted on services performed under prime contract with the owner at the 6 per cent basic figure for the entire project wherein the total cost of the project is $150,000 or more and 10 per cent for projects costing less.

Excluding intricate, small, and alteration work that should automatically come under the 10 per cent basic figure, all professional-engineering work could be performed profitably at the 6 per cent basic figure.

Payment of fee should be in increments with progress of the work that will aggregate the following approximate percentages of the total fee: Preliminaries, 20 per cent; final approved plans and specifications, 75 per cent; supervision at completion—acceptance, 5 per cent balance to make 100 per cent.

Services for Architects. In case of services performed for architects or other professional engineers—in other words, any work not contracted directly with the owners—a discount should be allowed on the accepted standard fee suggested in the foregoing.

In the case of services performed for architects or other engineers wherein approval of shop drawings, job inspections, and other supervisory functions are not included, compensation for conferences, investigations,

(*Continued on page 553*)

Engineering Aspects of Textile Structures

Development of new fibers and processes call for a dynamic approach to the blending of textile craftsmanship and textile science

By Kenneth R. Fox

Vice-President, Fabric Research Laboratories, Inc., Dedham, Mass.

THE APPLICATION of basic engineering concepts to the solution of problems which face mechanical engineers has long been recognized. Many of the fundamental data and formulas needed to work out problems of design and construction are readily available. Yet, although much has been said of the need for the application of sound engineering principles to the design of textile structures and the fruitfulness of such an approach, little has been done to capitalize on what is already known about textile fiber, yarn, and fabric properties. Too often the explanation is given that textile materials are too variable, too unpredictable, or too complex. To be sure, these materials are variable; they are also frequently difficult to predict; and certainly they are complex structures. But any material, be it steel, copper, cast iron, wood or concrete, is also variable, unpredictable, and complex. Nevertheless, in spite of these characteristics, engineers have been working with these items for centuries and have employed engineering methods in their use.

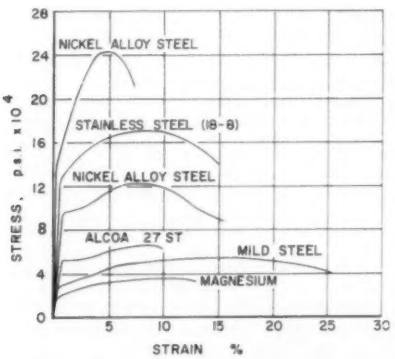

Fig. 1 Stress-strain properties of metals

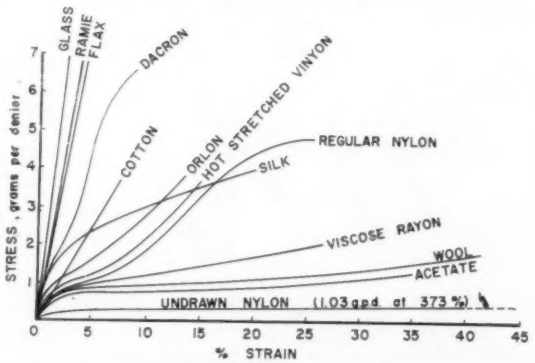

Fig. 2 Stress-strain properties of various well-known fibers

Materials

Conventional engineering materials as well as textile fibers differ widely in their physical properties. Fig. 1 shows the stress-strain properties of just a few well-known metals (1).[1] It will be noted that there is a wide variation in these properties. Ultimate strengths and elongations are widely different, yield points, elastic and plastic regions vary and, as a matter of fact, there are very few points of similarity. Multiply this selection of materials many times and some idea can be had of the myriad of metals available to the engineer for designing specific parts and structures.

Fig. 2 reveals that there is at the disposal of a textile engineer a similar wide variety of fiber properties from which a selection may be made for specific end uses. The extremes range from ramie, a high-strength low-extensibility fiber with an almost linear stress-strain curve and an almost perfect elastic behavior over the entire range, to undrawn nylon which manifests a mechanical behavior nearly comparable with a perfectly plastic medium. Between these extremes lie fibers evidencing a wide variety of intermediate values of such important regions of the stress-strain curve as initial slope, yield region, and postyield region.

Variability of Properties. Most materials whether they be conventional engineering materials or textile fibers react differently when ambient conditions are altered. Fig. 3 shows the change in the stress-strain properties of chrome iron with varying temperatures (2). In general, as the temperature increases, the moduli are reduced, yield points are lowered, and the stress-bearing capacity is reduced. With a knowledge of these characteristics, design problems can be anticipated. Similar studies (3) have been conducted on textile fibers. Fig. 4 indicates the change in nylon stress-strain characteristics when tested at +70 and —70 F. A second set of curves shows the change in a formic-acid-treated nylon over the same temperature range. In general, as temperature is decreased, the ultimate strength is higher, the ultimate elongation reduced, and energy-absorbing capacity increased.

Rate of loading certainly has a bearing on how ma-

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

Contributed by the Textile Division and presented at the Diamond Jubilee Semi-Annual Meeting, Boston, Mass., June 19–23, 1955, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

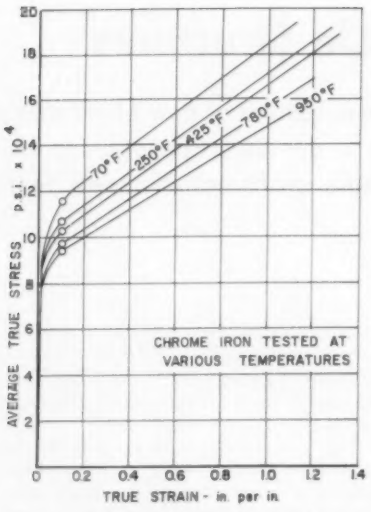

Fig. 3 Stress-strain for chrome iron at varying temperature-data from AIME

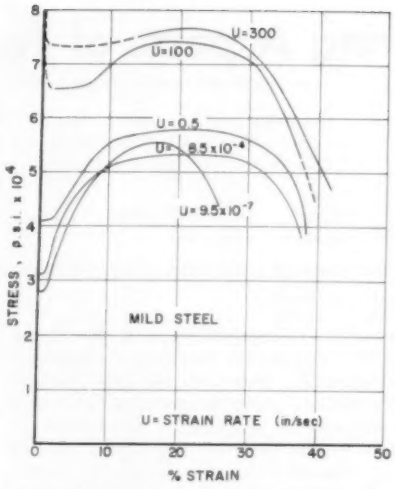

Fig. 5 Effect on stress-strain properties of metals at increase in loading speed

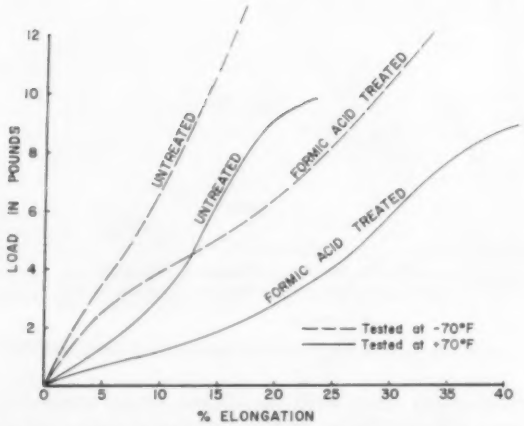

Fig. 4 Changes in nylon stress-strain characteristics at +70 and —70 F

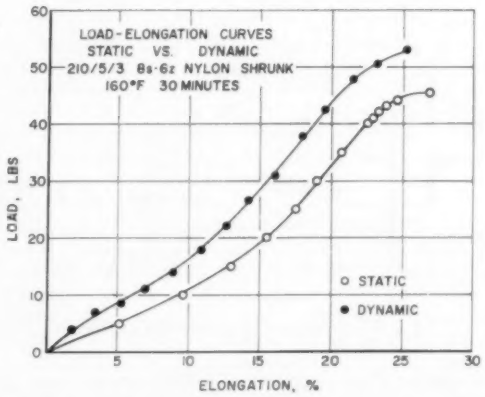

Fig. 6 Load-elongation curves of nylon when rate of strain is increased from 12 ipm to 30 fps

terials behave. This situation is well known when dealing with metals, and Fig. 5 indicates how the stress-strain properties vary as the speed of loading is increased (4). Fig. 6 shows how nylon behaves when the rate of strain is increased from 12 ipm to 30 fps (5). With greater differentials in speed, even more startling differences can be noted. The change in the impact properties of nylon is one of the reasons why this fiber lends itself so well to such items as flak suits and body-armor vests.

Many more analogies can be drawn between the similarity in properties of conventional engineering materials and textile fibers but it is thought these examples are sufficient to point out reasons why it is felt textile structures permit engineering as well.

Analysis of Stress-Strain Curve

It has been shown theoretically as well as empirically that for such textile structures as wearing apparel, decorative fabrics, and certain industrial uses, an analysis of the stress-strain curve at low strains in the range of 1 to 3 per cent is pertinent (6). Hence the initial slope regions of the curves is a potential region for investigation and should yield parameters useful in the design of textile structures.

It was pointed out earlier that the shape of the stress-strain curve for textile fibers was dependent upon time, i.e., rate of loading. If time, therefore, could be eliminated effectively, time-independent parameters could be obtained. This would permit the calculation of an immediate elastic deflection as well as point out the method for isolating the delayed elastic deflection which is recoverable with time and also the permanent deformation which is time-dependent but nonrecoverable. For purposes of this discussion, comments will be confined to consideration of the time-independent parameter, i.e., immediate elastic deflection.

A fundamental relationship which is of great importance and value in the study of mechanics of materials is the ratio of total stress to elastic strain, namely, the

modulus of elasticity. For materials which are effectively time-independent below the yield point, the calculation is simple. However, for viscoelastic materials such as textile fibers, other methods must be employed.

An effective instrument known as the "pulse propagation meter" (7) permits measuring the modulus of elasticity in essentially zero time. Through the basic relationship of pulse velocity through a specimen and specific gravity of the material, the modulus or its reciprocal, compliance, can be calculated.

Fig. 7 is illustrative of typical load-strain and load-compliance diagrams for single fibers of hair, wool, and acetate rayon (6). Since the two diagrams are produced simultaneously for each fiber, they may be compared directly in the analysis of deformation components. The load-strain curves depict the total deformation corresponding to a given load while the load-compliance diagrams afford a means of determining the immediate elastic deflection at any load. This is accomplished by integrating with respect to load the area under the load-compliance curve. This has been done for a wide variety of fibers and is shown in graphical form plotted against total elongation in Fig. 8. A perfectly elastic material would be located on the one-to-one line as any selected strain and the more nearly the fiber curve conforms to this datum line, the more perfectly elastic would the fiber properties be. It is interesting to note that mohair, wool, Dacron, and silk show very well in this regard and these fibers are known to be traditionally good in elastic properties.

An analysis such as this permits evaluation of fiber properties which are important in such more subtle characteristics as resiliency, hand, drape, wrinkle resistance, wrinkle recovery and the like.

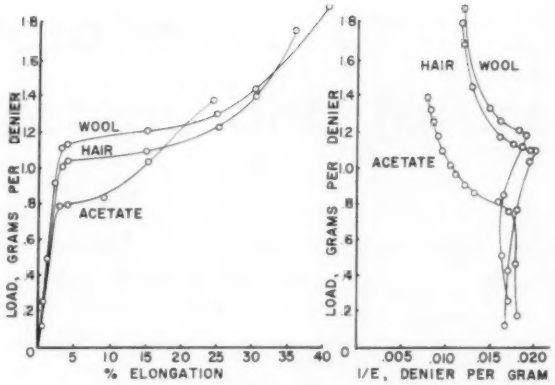

Fig. 7 Load-strain and load-compliance diagrams for single fibers of various kinds

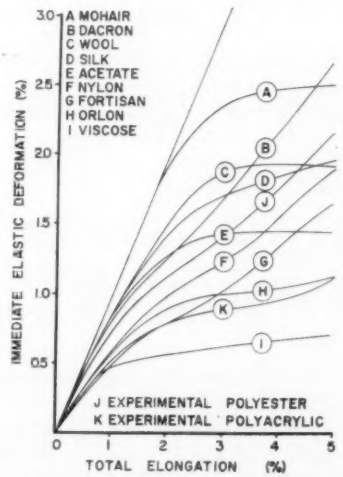

Fig. 8 Elastic deformation for a wide variety of fibers

Application of Stress-Strain Curves

In addition to the fiber evaluations shown possible by use of the stress-strain curve, there are many other applications involving yarns and fabrics (8). This applies not only to homogeneous and unidirectional systems but also to systems where different fibers and/or yarns are used in applications where stresses are multidirectional. Fiber blending is a typical example. It is well known that there are many reasons why different fibers are blended which include both economic and performance factors. Frequently these factors are interrelated as the more expensive fibers generally can command a premium because of outstanding characteristics in certain end uses. While fiber blending encompasses many properties which are not directly related to stress-strain properties, nevertheless the stress-strain relationships ultimately enter the picture to a major extent. Although tensile strength alone is a property that has been given prominence much beyond its true significance, it is interesting to analyze fiber blends by use of stress-strain curves and determine resultant strengths.

Consider that a blend is to be made of two fibers, A and B, which have the following properties:

Fiber A

Ultimate tenacity—5 grams/denier
Ultimate elongation—3 per cent

Fiber B

Ultimate tenacity—9 grams/denier
Ultimate elongation—6 per cent

Assume also that the stress-strain curves of both fibers are concave upward as shown in Fig. 9. If a yarn comprised of fibers A and B is D denier in size and if a is the percentage of material A by weight and b is the percentage of material B by weight, then

$$D_a = \frac{aD}{100}$$

and

$$D_b = \frac{bD}{100}$$

where D_a is the total denier of material A and D_b is that of material B.

For the first rupture point 1 (failure of material A), the total load supported by the composite yarn is

$$P_1 = P_{A1} + P_{B1}$$

but from the curves

$$P_{A1} = \frac{aD}{100} \times 5$$

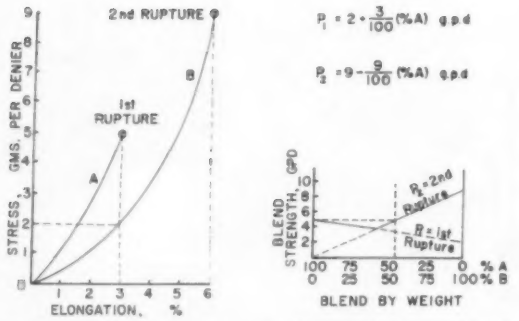

Fig. 9 Effects of stress-strain characteristics on blend strengths for yarns A and B

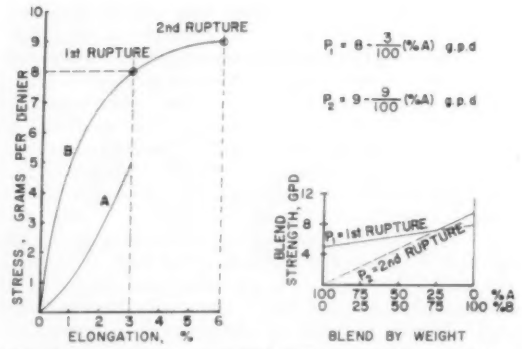

Fig. 10 Effects of stress-strain characteristics on blend strengths for yarns A and B

and

$$P_{B1} = \frac{bD}{100} \times 2$$

therefore

$$P_1 = \frac{D}{100}(5a + 2b) = \frac{D}{100}\,5a + 2(100 - a)$$

$$= \frac{D}{100}(3a + 200)$$

$$= 2 + \frac{3}{100}\text{(per cent A) grams/denier}$$

In the same fashion, at second rupture point B (failure of material B), the load supported by the composite yarn is

$$P_2 = 9 - \frac{9}{100}\text{(per cent A) grams/denier}$$

Graphically, the relationship of blend strength versus blend by weight is also shown in Fig. 9. It will be noted that up to blends of approximately 40 per cent of the stronger fiber B, the strength of the blend at the final rupture has decreased, and it is only until 55.5 per cent of fiber B has been added that the composite yarn strength at first rupture equals the strength of a yarn composed entirely of the weaker fiber A.

Consider, now, a blend where fibers A and B have the same ultimate tenacities and ultimate elongations as the former case, but the stress-strain curve for fiber B is concave downward, Fig. 10. In this instance

$$P_1 = 8 - \frac{3}{100}\text{(per cent A) grams/denier}$$

and

$$P_2 = 9 - \frac{9}{100}\text{(per cent A) grams/denier}$$

Referring to the blend strength-blend weight chart, and in contrast to the previous example, as fiber B is added to the blend, the composite strength curve increases continuously and all blends of these two fibers will be stronger than a yarn composed entirely of weaker fiber A. It is rather obvious that not only are the ultimate strengths and ultimate elongations important to consider in blending fibers for strength but more important is the relative shape of the stress-strain curves.

A Dynamic Industry

To those of us who have been close to the textile industry the last few decades, it must certainly be recognized that our industry is truly a dynamic one. Not too long ago the textile designer had but a few fibers from which to select his raw materials. Now he is confronted with a wide selection encompassing a correspondingly great diversity in physical and chemical properties. Additionally, methods of processing have become more varied and versatile. Processes which once were limited to rather confined fiber lengths now have their range of usable fiber staples greatly increased. Yarns are being spun from staple fiber with little or no twist, fabrics are no longer being woven in the conventional manner, and the use of mechanical and chemical treatments in finishing are more diverse and effective than ever before. And even more important, the surface has hardly been scratched.

The late Harold DeWitt Smith recognized the inevitable need of a sound engineering approach to the design and utilization of textile structures when he commented in his Marburg Lecture of 1944 (9) "...an engineering approach to the design and utilization of textile fibers, yarns and fabrics is needed in order to blend textile craftsmanship with modern textile science if the textile industry is to exploit its opportunities and meet its obligations in the world of today and tomorrow."

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Electric-Power Generation . . . . . Past, Present, and Future

Progress in hydroelectric, steam-electric, gas-turbine, mercury-steam generation, and future possibilities including nuclear power

By J. B. McClure[1] and A. G. Mellor[2]

General Electric Company, Schenectady, N. Y.

In the 73 years since the electric-utility industry began with the starting of Edison's Pearl Street Station in New York City on September 4, 1882, the generation and utilization of electric power has become one of the most important factors in our continuing expanding economy. Since then there has never been a serious shortage of power in this country and today the cost of power to the ultimate consumer, in spite of inflation, is at practically the lowest level in history.

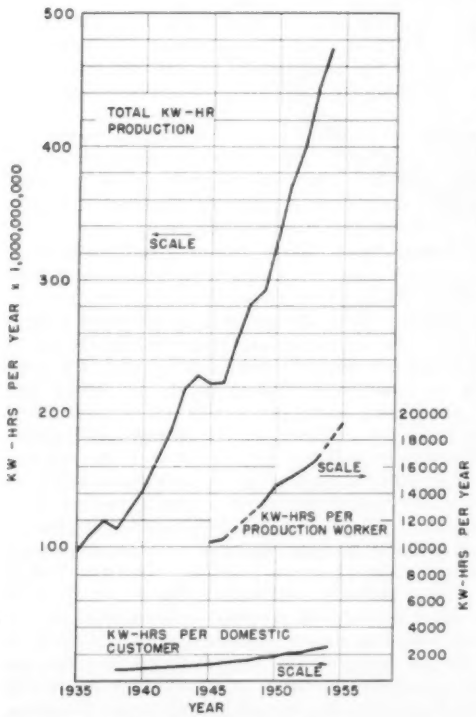

Fig. 1 Total electric-power production; consumption per production worker and consumption per domestic customer by years

Use and Sources of Electric Power

The rapid increase in the use of electric power in the United States is illustrated in Fig. 1. For many years past the consumption of electric power has more than doubled every 10 years and there are many indications that this rate of increase will continue in the future.

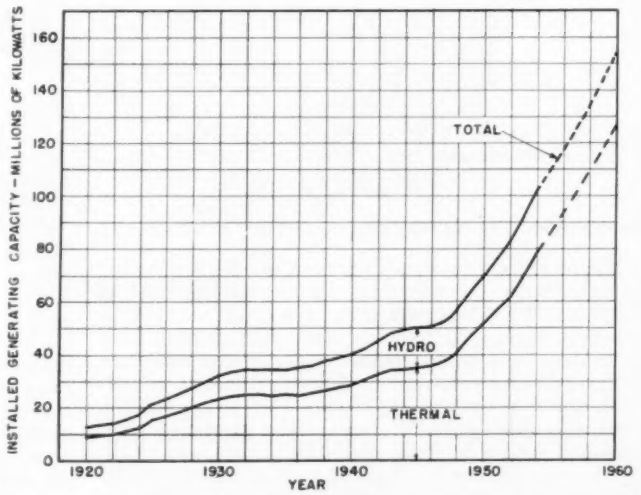

Fig. 2 Total installed hydro and thermal generating capacity growth

Two major sources of power, hydro and steam, have accounted for the major part of electric power production. Fig. 2 shows the total installed generating capacity in this country from 1920 to the present and also a breakdown between hydro and thermal generation. In 1920 hydro generation was about 29 per cent of the total generating capacity. Today it has fallen to about 23 per cent notwithstanding the very large government hydro installations made during the past 20 years. Included in the total thermal generation shown in Fig. 2 is a small amount of internal-combustion generation. This amounted to an installed capacity of about 2,276,000 kw at the end of 1954, mostly in small generating units. Steam-electric generating capacity at the end of 1954 thus amounted to about 76 million kw or 75 per cent of the total.

[1] Manager, Power Generation Engineering. Mem. ASME.

[2] Senior Engineer, Power Generation Engineering, Engineering Planning and Development Section. Mem. ASME.

Contributed by the Machine Design Division and presented at the Diamond Jubilee Annual Meeting, Chicago, Ill., November 13–18, 1955, of The American Society of Mechanical Engineers. Condensed from ASME Paper No. 55—A-98.

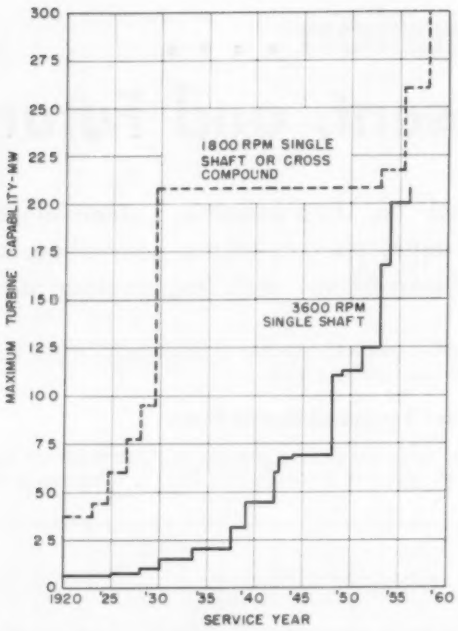

Fig. 3 Maximum size of turbine-generator units in service in various years

Developments in Hydroelectric Generation

Hydroelectric development in the United States started in 1882 when the first small station was installed at Appleton, Wis. Following this early development progress was rapid. In 1889 the first alternating-current generating unit was installed at the Willamette Falls Electric Company, Oregon. This was followed in 1895 with the development of Niagara Falls using 5000-hp vertical turbine-generator units. The rating of units increased rapidly to about 18,000 hp in 1910, and 55,000 hp in 1920. Today the highest rated units are 150,000 hp at 120 rpm; however, several units with lower kva rating are of larger physical size.

Horizontal impulse turbines have been used for many high-head developments but more recently vertical impulse turbines have been developed. For lower-head installations, reaction turbines and vertical generators have been used. During the 1920's propeller-type turbines with adjustable blades were developed to permit higher-speed operation on low-head installations. This resulted in smaller and more economical machines.

A few outdoor hydrogenerator installations have been made but this practice has not been widely accepted in the industry.

The design of equipment for hydrostations has now reached a point where further improvements become increasingly difficult. Waterwheel efficiencies are of the order of 90 per cent and waterwheel generator efficiencies are from 97 to 98.5 per cent.

During the past several years there has been an increasing trend toward the use of automatic control for unattended operation of hydroelectric generating units or for supervisory control from a remote point. Control of this type has been applied to generating units up to 37,500 kva with appreciable savings in operating labor costs.

Developments in Steam-Electric Generation

Since the installation of the Pearl Street Station in 1882, many major developments have occurred in equipment and general station design.

Turbine Developments. Early steam-electric generating units were driven by reciprocating engines and this type of prime mover was developed to a capacity of about 5000 kw by 1903. However, shortly before 1900, steam turbines were being developed to drive electric generators. The early turbines were horizontal machines and the first unit to operate on a utility system was rated 1500 kw at a speed of 720 rpm, and was shipped to Port Huron Light and Power Company early in 1903. In 1902 development work on vertical turbines was under way and early in 1903, 5000-kw vertical turbines for Commonwealth Edison Company were being shipped.

The size of turbines increased to 9000 kw in 1907, with the units operating at 750 rpm and with steam conditions of 200 psig and 125 F superheat.

In 1908 renewed interest was shown in horizontal turbines and a 1500-kw unit operating at 1800 rpm was built. Work on the development of this type continued with the maximum size increasing by 1917 to 45,000 kw at 1800 rpm.

The period 1911–1913 was the high point in the development of vertical turbines with the size increasing to 20,000 kw in 1911. This was considered the practical upper limit in size for this type of machine and 1913 saw the end of vertical-turbine production.

Early Auxiliary Drives. Early turbine installations commonly had their auxiliaries driven by small steam turbines. The exhaust from these auxiliary turbines was used for heating the feedwater in a single open heater. Turbine cycle efficiency was later improved by the use of multistage regenerative feedwater heating by extractions from the main turbine. Motor drives for boiler and turbine auxiliaries have practically entirely replaced auxiliary turbines. There are, however, indications today that for very large, high-pressure units turbine-driven boiler feed pumps may be an economical solution.

In the early 1920's maximum steam pressures were raised from the 350-psi level to 550 psi and then shortly afterward to 1000 psi and 1200 psi. During this same period steam temperatures advanced only from 700 to 750 F. Since steam temperatures could not then be further raised because of material limitations, the reheat cycle was introduced. Use of reheat not only increased the over-all cycle efficiency but also overcame the problem of excessive moisture in the exhaust end of turbines resulting from the use of higher steam pressures. A few years later when improved materials made it possible to increase turbine-inlet temperatures, the use of the reheat cycle greatly decreased and was not again used on a large scale until after World War II.

Topping Turbines. In 1925 and 1926, 3600-rpm topping turbines designed for 1000 psi and 1200 psi initial steam pressure were installed.

Size of Generating Units. The size of generating units continued to advance rapidly as shown in Fig. 3. In 1929 a 208,000-kw triple cross-compound unit was installed in the State Line Station near Chicago. Until very recently this was the largest single generating unit in existence. In 1931 a 110,000-kw, horizontal-shaft

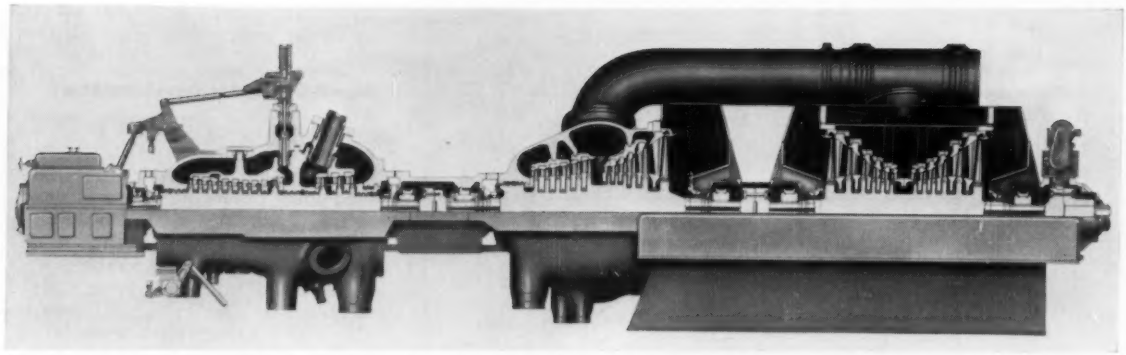

Fig. 4 Typical 3600-rpm tandem-compound triple-flow turbine rated at 200,000 kw, 2000 psig, 1050 F/1050 F

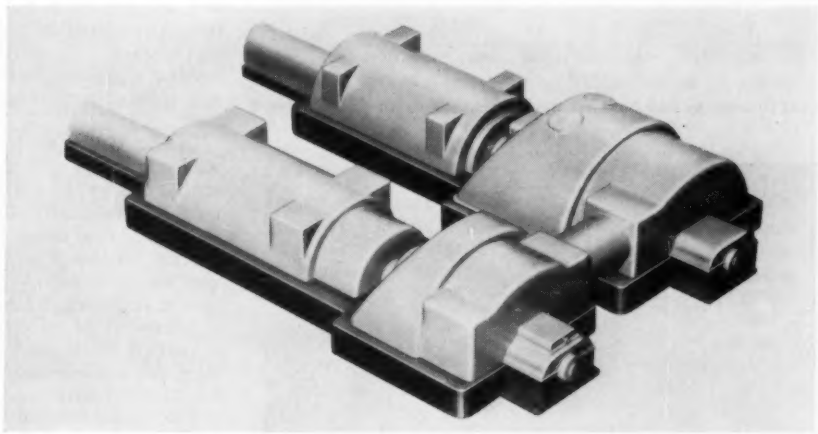

Fig. 5 Large close-coupled, 3600/1800-rpm, cross-compound, turbine-generator unit

vertical compound, 1800/1800 rpm, was built for steam conditions of 1200 psi, 750 F initial temperature with reheat to 550 F. In 1932 a 160,000-kw, tandem-compound, double-flow, 1800-rpm unit was built.

With the introduction of higher steam pressures it became feasible to improve the efficiency of many old 200-psi installations by the use of new, high-pressure boilers and topping turbines. During the period of 1930–1940 many installations of this type were made.

Forerunner of High-Pressure Units. In 1941 a significant step was made with the construction of a 2350 psig, 940 F initial temperature, 900 F reheat temperature unit at the Twin Branch station of Indiana and Michigan Power Company. This was a forerunner of the high-pressure units that have become so common since World War II.

By the start of World War II the maximum steam pressure in use was 2300 psig, the maximum steam temperature was 1000 F, and the maximum size of 3600-rpm generating units was about 60,000 kw.

Recent Turbine Developments. Turbine developments since the end of World War II have come at a rapid rate. In 1947 the first 100,000-kw, 3600-rpm unit was put in service. Since that date, increase in the size of 3600-rpm units has continued until now 200,000-kw, tandem-compound, triple-flow units are in service and even larger units are being built. Fig. 4 illustrates a typical large turbine-generator of this type. These very large 3600-rpm units have been made feasible by the development of longer last-stage buckets—the 23-in. bucket being first used in 1947, and the 26-in. bucket in 1954. The availability of these very large 3600-rpm units has resulted in practically no 1800-rpm units being built except as the low-pressure elements of cross-compound units.

Recent Generating Units. Many of the largest generating units in recent years have been cross-compound using a 3600-rpm high-pressure turbine and an 1800-rpm low-pressure turbine. Sizes of this type of unit have increased to 217,000 kw in service with units over 300,000 kw on order. The larger exhaust-annulus area obtainable from a single wheel on an 1800 machine makes cross-compound units attractive in the large sizes, particularly where condenser-cooling-water temperatures are low.

A recent development has been the close-coupled cross-compound unit, Fig. 5, in which the two shafts are located as close together as possible and a single foundation can be used. This design not only results in a saving in building space, but also reduces the volume of steam between the two turbines and so alleviates the overspeed problem on load rejection.

Steam Temperatures and Pressures. To achieve greater

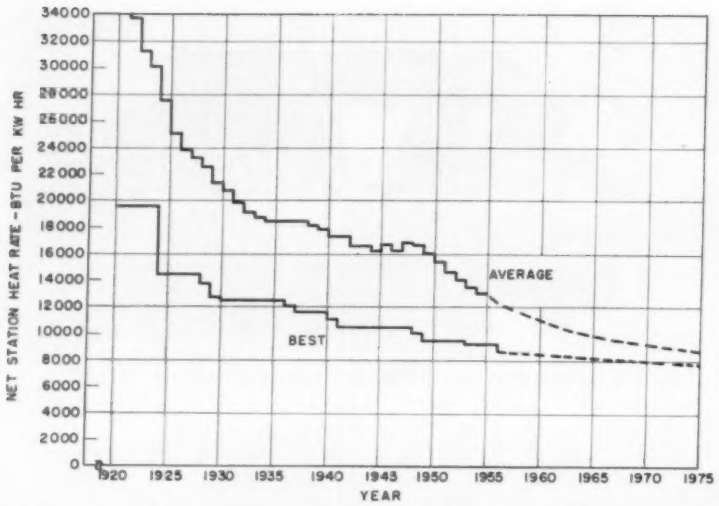

Fig. 6 Improvement in average and best net station heat rate with time

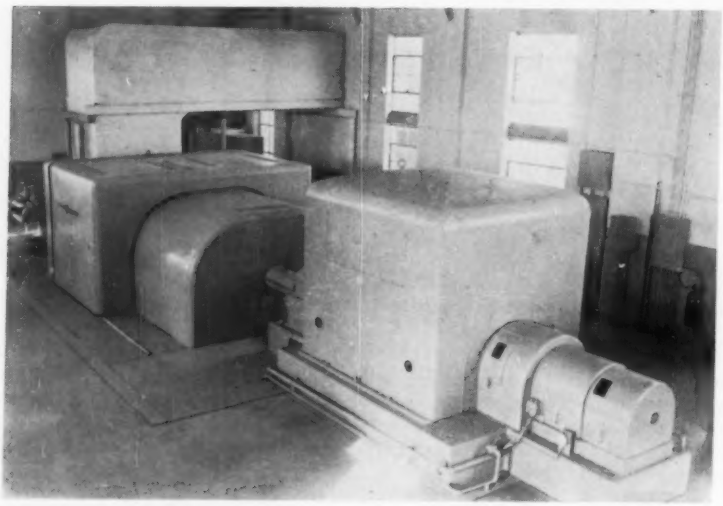

Fig. 7 3500-kw regenerative-cycle, two-shaft gas-turbine generating unit

efficiency, initial steam temperatures have continued to increase with an initial temperature of 1050 F now quite common. A few machines for an initial temperature of 1100 F are now in service and others are being planned for 1150 F. Steam pressures have remained at a maximum of about 2300 psi for several years but the first machines for supercritical-pressure operation are now being built —one for 4500 psi throttle pressure and another for 5000 psi. The effect of improved efficiency on station heat rate is shown in Fig. 6.

Reheat Cycle. The continuing desire for higher efficiency brought about a revival of the reheat cycle and practically all large turbines now going into service are for this cycle. The first large postwar reheat machines were a group of 150,000-kw cross-compound units designed for 2000 psi 1050 F initial temperature and 1000 F reheat temperature. Reheat has since been employed on turbines down to 40,000 kw and up to the largest sizes being planned.

Steam-Generator Developments

Boilers to supply steam to the engine-driven generators in the Pearl Street Station were water-tube hand-fired units, producing saturated steam. A few years later with the development of the steam turbine, higher steam pressures and temperatures were utilized and superheaters were added to boilers as a means of heating steam above the saturation temperature. Boilers increased in size and hand firing was replaced with stoker firing.

The use of higher steam pressures and temperatures and greater steam outputs resulted in higher heat losses up the stack. To recover part of these losses it was found to be economical to add economizers or air preheaters, or both.

In the 1920's pulverized-coal firing was introduced and made very rapid strides and by the early 1930's it was used on practically all large boilers. Pulverized-coal firing improved combustion efficiency and made possible increases in steam output without excessive increases in boiler size. Early applications of pulverized-coal firing retained brick-lined furnaces which were often air-cooled to prolong the life of the lining.

The development of water-cooled furnaces was brought about by the need for improved furnace linings. The tubes forming the water-cooled surface of the furnace were an integral part of the boiler system and were utilized to absorb heat for steam generation. With this design the use of refractory materials has been practically eliminated with a considerable improvement in boiler reliability.

Boilers for the Reheat Cycle. In the mid-1920's the reheat cycle was introduced. Boilers used at that time for this cycle usually consisted of several boilers and superheaters and a separately fired reheat unit. In some installations steam reheaters were used. In the more recent reheat installations made since World War II the reheater has been included in the main steam-generating unit.

Increase in Steam Output. One of the major achievements of the boiler-manufacturing industry has been the increase in steam output of the units. In 1924 the steam output of the largest boilers available was sufficient to produce about 10,000 kw of electric power. By 1929 this had increased to 20,000 kw; to about 27,000 kw in 1930; and to about 100,000 kw by 1940. Since this latter date boiler capability has matched the capability of available turbines and so single boiler-turbine installations are now practically universal. There is no indication that the upper limit in boiler capability

has yet been reached. Recent designs utilizing a twin furnace open the way to further large increases in the output of single steam-generating units.

Burning Lower-Grade Coal. Significant advances have been made in recent years in the development of equipment to burn lower grades of coal while at the same time controlling the amount of fly ash that will be carried up the stack. Control of initial and reheat-steam temperatures has received a large amount of attention. Different manufacturers have developed various methods of accomplishing this successfully, including differential firing, use of tilting burners, gas by-passes, gas recirculation, attemperation, and so on.

Pressurized Boilers. Within the past few years the use of pressurized boilers has been increasing. In these designs only forced-draft fans are used and the furnace is operated at a positive pressure. The elimination of the induced-draft fans not only reduces the total fan power required but eliminates the high maintenance expense on the induced-draft fan.

With all the developments and improvements that have been incorporated in recent boiler designs, efficiency has now reached 90 per cent or better in many of the larger units. At the same time, reliability has been improved to the point where outages, except for mandatory annual inspections, are very few.

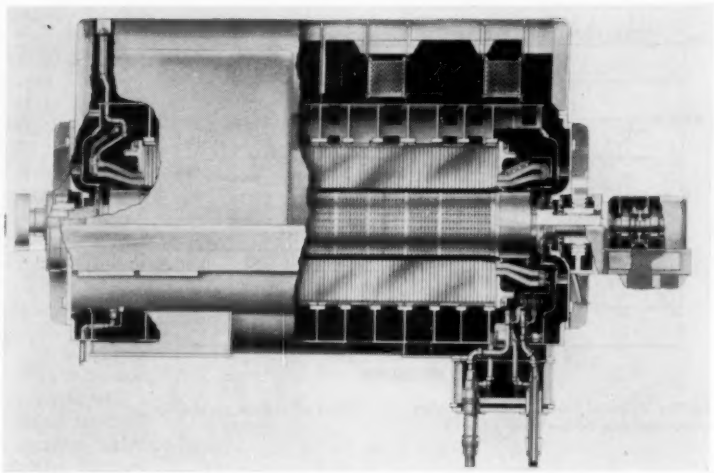

Fig. 8 Conductor-cooled turbine-generator with gas-cooled rotor and liquid-cooled stator

Generator Developments

Developments in turbine-driven generators have been equally as remarkable as developments in turbines and boilers. Early generators were 900, 1200, or 1800-rpm units to match the turbine speeds then being commonly used. The move to 3600-rpm generators has been dictated by turbine requirements where high steam temperatures and pressures required a 3600-rpm design.

In 1915 forged generator rotors were introduced and all subsequent generator designs have employed this construction.

In 1927 welded generator frames were introduced to replace cast frames resulting in greater strength and reduced weight.

Generator Cooling Methods. Early machines were open air-cooled, but later totally enclosed machines with air coolers were introduced. The major development in generator cooling was the introduction of hydrogen cooling in 1937, and practically all machines 16,500 kw and larger are now hydrogen-cooled. Hydrogen pressure initially used was $^1/_2$ psig but more recently 15 psig and 30 psig or higher have been used.

Prior to the introduction of hydrogen cooling, many large air-cooled generators employed a double-frame design due to shipping limitations. With the introduction of hydrogen cooling, this type of construction was no longer necessary. It was possible to continue the use of single-frame construction even for very large 3600 and 1800-rpm generators as a result of continued improvement in materials and design techniques. Typical of improved magnetic materials is oriented grain strip steel which is now being used on many large generators.

The recent development of an aluminum alloy has made it possible to increase the diameter of the generator rotor and this has brought back the use of double-frame construction for the largest conventionally cooled machines in service, rated 220,000 kva at 30 psi hydrogen pressure.

Developments in Station Design. As improved equipment has become available it has been possible to make major improvements in general station design. The availability of boilers large enough to supply the steam requirements of the largest turbines has made it possible to eliminate steam headers with a considerable saving in cost. This is particularly important with the present use of high steam temperatures and pressures, and the reheat cycle.

Similar simplification has been achieved in the electrical end of the station. Improved reliability has made it possible to eliminate generator busses and switchgear at generator voltage and to use a single step-up transformer for each generator.

Operation of modern steam stations has become almost entirely centralized with a consequent reduction in operating labor costs. This has been made possible by the development of automatic controls and remote instrumentation.

Starting about 1930, several outdoor station installations were made, particularly in the southern part of the country. Some of these used only semioutdoor boilers while in others the entire boiler and the turbine were completely exposed. General acceptance of outdoor generating stations awaited the development of instrumentation and automatic controls that permitted practically all routine operations to be performed from a centralized control point.

Widespread acceptance of this equipment has resulted in a rapid increase in outdoor stations. Stations of this type are now in operation as far north as Montana and New York.

Developments in Internal-Combustion Generation. As indicated previously, there was about 2,276,000 kw of internal-combustion generating capacity installed in the

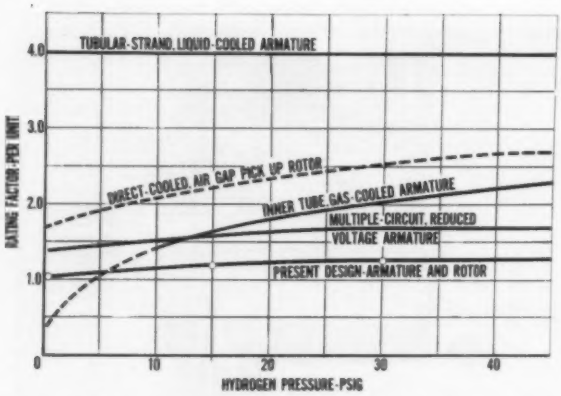

Fig. 9 Typical rating factors for various types of armature and rotor cooling of turbine-generators

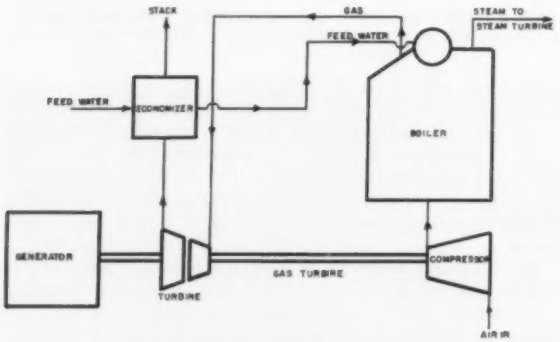

Fig. 10 Simple-cycle gas turbine supercharging a steam boiler

United States at the end of 1954. This consisted of about 1225 plants using internal-combustion engines which give an average plant capacity of about 1860 kw.

Most internal-combustion engines being used are in the range of 1000 to 2000 kw and the largest units are about 7000 kw.

Recent improvements have been made in the ability of reciprocating engines to use more than one type of fuel—oil and natural gas—or a mixture of these fuels. However, the inability of reciprocating engines to burn coal limits their use in many parts of the country.

Developments in Gas-Turbine Generation. Development work on gas turbines has been under way for many years, but early attempts to build workable units failed, largely because of the inefficiencies of the components and the lack of metals capable of withstanding high operating temperatures. The development, about 1930, of improved compressors and turbines, together with the availability of high-temperature metals, marked the real beginning of the modern gas turbine. The development of successful jet aircraft engines during World War II led to further development of stationary gas-turbine units.

The first gas-turbine generating unit to be installed in this country was a 3500-kw unit in 1949, in the Belle Isle Station of Oklahoma Gas & Electric Company. This unit operates on natural gas and has had a remarkably good operating record. Following this initial installation, several additional units in the size range of 3500 to 5000 kw have been installed to operate on natural gas and on residual oil. Turbine-inlet temperatures used on these units range from about 1400 to 1500 F and heat rates range from about 13,000 Btu/kwhr to 20,000 Btu/kwhr. Fig. 7 shows a regenerative-cycle, two-shaft, gas-turbine generating unit.

The large-scale use of gas turbines for power generation has been held back by the fact that only relatively small-size units so far have been available and also by the inability of the gas turbine to operate successfully as yet on coal.

Developments presently under way may well insure a place for the gas turbine in future power generation, particularly in combined gas-turbine steam-turbine cycles which will be discussed later.

The Mercury-Steam Cycle. The mercury-steam cycle was first seriously proposed for power generation in 1913. After several years of tests and development, an experimental 1800-kw unit was built in 1922. In 1928 the first commercial power-generation unit went into operation at the South Meadow Station of the Hartford Electric Light Company. This was a 10,000-kw mercury topping plant superposed on existing 400-psig, 700 F, steam-generating equipment. Additional units were installed in 1933 and in 1949.

While the mercury-steam units have operated satisfactorily and a good net station heat rate has been obtained (about 9400 Btu per kwhr) there has been practically no activity in this field for several years.

Future Power

If, as predicted, the demand for electric power doubles in the next 10 years it will be necessary to add over 100,000,000 kw of new generating capability by 1965, in addition to replacing any old obsolete generating capacity that may be retired. An extension of developments presently under way can provide a picture of what this new generating capacity to be added will be like and what will be some of the future trends in the industry.

New hydroelectric installations can provide only a small part of our future power requirements. By 1965 electric power from atomic energy may be supplying a part of our requirements but it seems certain that the major source of power for some time in the future will be fossil-fueled steam-electric generating stations.

Steam-Electric Generating Stations. The present trend to larger single generating units can be expected to continue. As mentioned previously, two plants are now under way that are designed to operate at supercritical steam pressures and using a double reheat cycle. Already consideration is being given to steam pressures of the order of 6000 to 7000 psig.

If these first two supercritical-pressure plants are successful it can be expected that in the future many of the largest generating units will employ steam conditions well advanced over those in use today, providing they can be justified economically.

Historically, the maximum steam temperature in use has increased on the average about 12 deg F per year. A continuation of this trend would result in the maximum steam temperature in use by 1975 of 1400 F. What this would mean in net station heat rate is shown in Fig. 6, where the heat-rate curve has been extrapolated to 1975

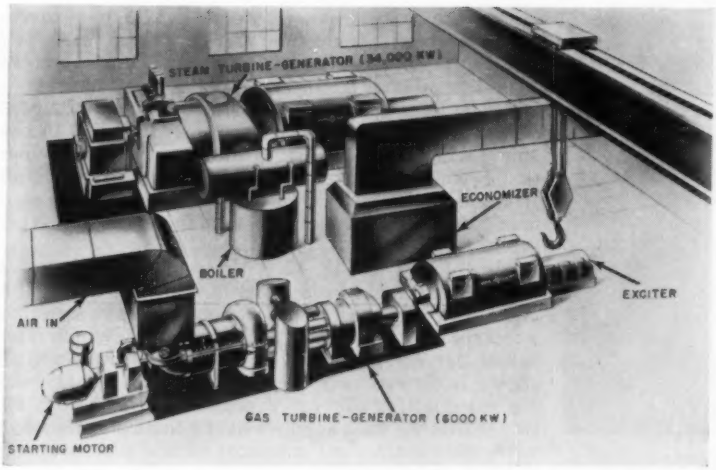

Fig. 11 Proposed equipment arrangement in a 40,000-kw supercharged boiler plant utilizing a gas-turbine compressor

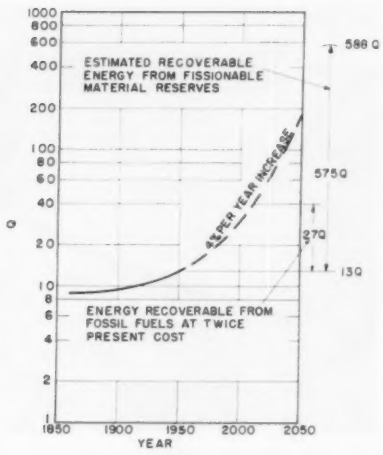

Fig. 12 Cumulative energy requirements and fuel reserves

on the assumption that generating units for operation at 10,000 psig, 1400 F/1300 F/1250 F will be available at that time. Also shown in Fig. 6 is the expected average heat rate of station in service. This average will tend to approach the best heat rate as new, efficient stations are added at an increasing rate.

To obtain these potential gains in station heat rate it will be necessary to use very large generating units. Thus increases in size and advanced steam conditions may well be concurrent developments. Developments presently under way by both boiler and turbine-generator manufacturers would seem to insure that these potentialities can be achieved.

In the boiler field, designs of once-through boilers are well along not only for supercritical pressures but also for more conventional pressures. Extension of these designs, together with the use of multiple furnaces should provide the very large very high-pressure boilers required for the future.

In both the boiler and turbine field the continuing development of materials suitable for high temperatures will make possible a continuation of the historical upward trend in steam temperatures.

One of the outstanding developments in generator design that has made it possible to build single-shaft, 3600-rpm turbine-generator units of much larger kva capacity has only recently been applied. This is the development of conductor cooling of both the rotor and the stator of large 3600-rpm generators. For rotor cooling, hydrogen gas is brought into direct contact with the conductor, thus eliminating the thermal drop across the insulation. Similar direct cooling methods are being introduced for the generator armature. In one of these methods a liquid is passed through the armature conductor and then passed through heat exchangers. A cross section of a generator of this type is shown in Fig. 8. In another method, hydrogen gas is passed through a channel in the conductor. Fig. 9 shows the effectiveness of these methods of generator cooling in increasing the output of 3600-rpm generators for a given frame size.

These generator-cooling developments have made it possible to build tandem-compound 3600-rpm turbine-generator units of very large ratings. However, for the larger ratings it may be more economical to consider 3600/1800 rpm cross-compound units. These machines can be built for optimum efficiency without a large number of parallel steam paths in the exhaust end.

Generating-Station Operation for System Economy. Automatic generator voltage regulators are now almost universally used. Their use readily permits generating stations to follow a daily or hourly voltage schedule to aid in control of voltage at the load, thereby minimizing the installation of expensive voltage-regulating equipment in the distribution system. Automatic control of generator excitation permits application of more economical high-reactance machines and also permits the application of reactive correcting equipment at the economically desirable location in the distribution system with associated safe operation of generators at high power factor.

The outputs of generating stations have been controlled automatically for many years to satisfy system frequency and salient tie-line requirements. Recent developments in computing techniques now make it possible to control generating-station outputs for maximum system economy, taking into account the station heat rates, the fuel costs, as well as the transmission-line losses.

Electrical Generation From Process-Steam Supply. In conventional condensing steam-electric stations the rejection of the latent heat of condensation to the circulating water accounts for the major loss of heat and corresponding reduction in efficiency for the over-all cycle. Many processes requiring large amounts of heat use steam at low or medium pressures and use all the latent heat of condensation in the process. By generating steam at high pressures and temperatures and employing condensing-extraction turbines with extraction steam exhausting to the process, electric energy may be generated at approximately 4000 Btu/kwhr. Several installations have been made in this country on a cooperative basis between the electric-utility and other industries requiring process steam and it is expected that the future will see many more of these advantageous installations.

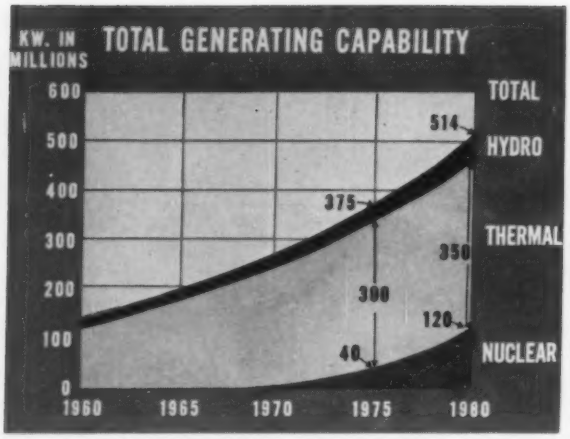

Fig. 13 Estimated future sources of electric power generation

Gas-Turbine Stations. The recent development of larger-sized gas turbine-generating units will make this type of unit applicable to larger power systems. The present fuel situation has been discussed previously. The development of a coal-burning gas turbine which would be applicable to a larger number of the country's power systems has been given considerable attention in the past few years and a solution to the problems involved will very likely be achieved within the next few years.

One of the most attractive possibilities for more efficient power generation in the near future is the use of a combined gas turbine–steam turbine cycle as shown in Figs. 10 and 11. In this cycle the gas-turbine compressor supplies combustion air to a boiler at a pressure of several atmospheres. Combustion takes place in the boiler, and steam at any desired pressure and temperature can be produced. The products of combustion leave the boiler at a temperature high enough to be suitable for operation of the gas turbine. After expanding through the turbine, additional heat is extracted from the gas in an economizer and/or an air preheater before going to the stack.

With a gas-turbine inlet temperature that is being used today in gas turbines this cycle results in about a 6 per cent reduction in net station heat rate over a conventional steam cycle using the same steam pressures and temperatures. Use of this cycle with future more advanced steam conditions will result in about the same decrease in net station heat rate provided the allowable gas-turbine inlet temperature will be as much above allowable steam-turbine-inlet temperature as is practical today (about 400 F).

Developments in Nuclear Power. During the past year or more, considerable emphasis has been placed on the importance of the early development of electric power production from nuclear sources. Apart from the considerations of national prestige, the development of nuclear-powered electric generating stations is important because of the situation in regard to world energy resources.

The total use of energy in the world, and particularly in this country, has been increasing at a tremendous rate. With this increase in the consumption of energy has come a transition from the use of "income" sources of energy such as water-power, wood, and the like, to the use of "capital" sources of energy such as coal, oil, natural gas, and so on, until now we are almost wholly dependent on these latter sources.

Fig. 12 is a plot of the cumulative world consumption of energy from 1850 to 2050. This plot is in the unit Q which is equivalent to 10^{18} Btu. The extrapolation beyond the present is based on the estimated increase in the population of the world and also an estimated 4 per cent increase per annum in the energy use per capita.

Also plotted in Fig. 12 is the estimated cumulative energy recoverable from fossil fuels at not more than twice the present cost of production. It can be seen that a total of 40 Q is estimated to be recoverable which is far below our energy requirements for the future. Also shown is the estimated energy recoverable from fissionable materials, assuming economic breeding. It is apparent that we must supplement our fossil-fuel resources with other sources and at present nuclear sources appear to be the most promising.

On April 1, 1955, five proposals were made to the Atomic Energy Commission by privately owned utility companies and other industrial groups to build nuclear-powered electric generating stations. While these proposals do not indicate that the first generating stations will be economically competitive with conventional generating stations, the knowledge acquired in building these plants may well result in competitive power from nuclear plants within the next few years.

Estimates have been made of the probable installed cost and fuel costs of future nuclear power plants based on present and proposed development programs. Making reasonable assumptions regarding future developments in conventionally fueled power stations, future cost of fossil fuels, fixed-charge rate, expected plant-load factors, etc., estimates have been made of the probable amount of nuclear-powered electric generation in future years.

Fig. 13 shows the result of these estimates. The total electric-power requirement of the country has been assumed to increase at the rate of 6.5 per cent per year and estimates have been made of the amount of hydro, conventional steam-electric, and nuclear-powered generation that will be in service for several years in the future.

One of the most significant factors to be seen in Fig. 12 is that while nuclear-powered generation becomes an appreciable factor in total power production by 1980, conventional steam-electric generation in service at that time will be more than four times the present installed capacity of this type. This emphasizes the necessity of continuing aggressively the development of more efficient fossil-fuel-fired electric-generating equipment to obtain the optimum efficiency for our power-generation sources.

Nation's Largest Business. Power generation is a major part of the country's largest business. The electric-utility industry not only ranks first in over-all investment, having surpassed the railroads in 1952, but is increasing at a faster rate than the country's manufacturing industries as a whole. In 1953 the investment in this industry was approximately 15 per cent of that in all the manufacturing plants and equipment in the United States and accounted for 23.5 per cent of the investment expenditure for that year. Present rate of growth will require 100,000,000 kw of additional generation in the next 10 years.

Friction

In a Close-Contact System

Fundamental aspects of problem and experimental evidence supporting new inferences with regard to friction

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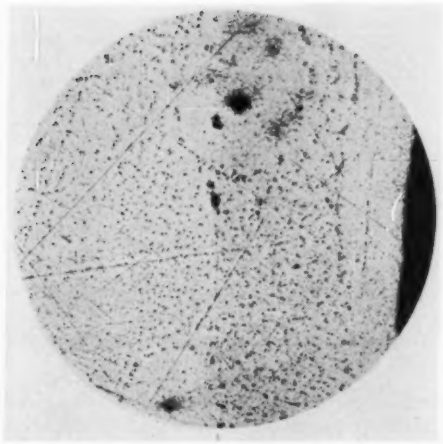

Fig. 1 Platinum-platinum: rhodium cold weld complete fusion; magnification ×1000

A SURVEY of the literature of friction over the past 50 years or so reveals that workers in this field have developed a vast and growing awareness of the complexity of the problem—in particular the phenomena associated with a very thin lubricating film between rubbing surfaces.

One objective of this paper is to discuss, on a theoretical basis, certain fundamental aspects of the problem of close-contact friction. A second objective is to present experimental evidence in support of the inferences drawn.

The term, "close-contact," is used to describe a friction system in which two solid test specimens, separated only by a thin film of foreign material, are brought into contact with each other under pressure. The geometry of either or both of the contacting surfaces may be "rounded" or "flat." Their mechanical finish may vary from "rough" to "smooth." If the separating film is oil, its thickness may vary within relatively wide limits depending on the degree of surface finish. In any event, its maximum thickness must not be greater than the maximum height of opposed surface elevations.

It is desirable at the outset to attempt a clarification of such terms as "clean" and smooth, since an understanding of their real meaning will further an understanding of the basic mechanism of close-contact friction.

Concept of a Clean Surface

In the absolute sense a "clean surface" implies the complete absence of any material other than that of which the surface is the outer boundary. Such a concept would exclude automatically the presence of an adsorbed film of water or of gas derived from the atmosphere.

Under selected conditions and by the use of special techniques it is possible to make a very close approach to absolute cleanness of surfaces. Examples follow:

1 In an experiment[1] wires of platinum and platinum-rhodium were cleaned in a hot flame in the presence of a flux of acid potassium sulphate. When the wires were cold they were brought in contact under sufficient pressure to cause plastic deformation. A bulk-strength weld resulted. The weld was sectioned, polished, and etched. Photographs at 1000-fold magnification indicated that molecular contact had been established across the interface. One such photograph is shown in Fig. 1. Location of interface is indicated by differing etch patterns.

2 A hardened-steel rod having a circumferential nick to permit easy breaking was completely immersed in a dish of freshly distilled air-free mercury. When broken, the surfaces at the fracture were immediately wetted by the mercury, proving a state of absolute surface cleanness.

All common metals exposed to air acquire a contaminating film, usually an oxide, the result being that the short-range field of force resident on the surface of the native metal is now masked or neutralized. It is this sealing-off mechanism which is responsible for so many striking differences in the physical and chemical properties of clean and contaminated surfaces.

Concept of Surface Smoothness

Surfaces of perfect figure and smoothness are, and must remain, geometrical abstractions. Molecular smoothness, however, is a practicable possibility and is exhibited in nature by the still clean surface of a liquid subject to the action of surface-tension forces. The "degree" of molecular smoothness of the surface of a liquid, however, may vary within wide limits, vapor pressure being the major factor concerned. For example, the vapor pressure of water at 20 C is 17.5 mm Hg while that of mercury at the same temperature is 0.0012, a ratio of 14,500 to 1.

The surface of the water may be regarded as in a state of violent molecular agitation which continues during the process of evaporation. On the other hand, the surface of the mercury is comparatively quiescent partly because the molecules have much less mobility but mainly because the rate of loss of surface molecules is so very small. In effect, the degree of smoothness of the surface may, without much error, be equated to the dimensions of the mercury molecule.

[1] "The Nature of Static Friction," by W. Claypoole and D. B. Cook, *Journal of The Franklin Institute*, vol. 233, 1952, pp. 453–463.

Contributed by the Research Committee on Lubrication, under the auspices of the Lubrication Activity of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, and presented at the First Annual ASME-ASLE Lubrication Conference, Baltimore, Md., October 18–20, 1954. Condensed from Paper No. 54—LUB-6.

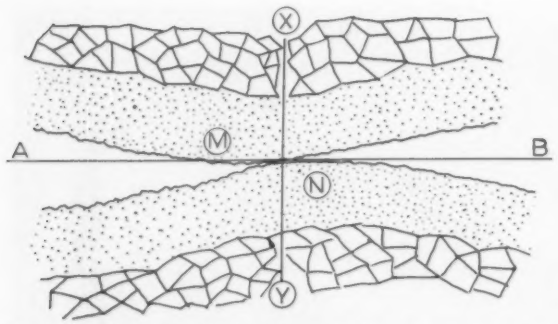

Fig. 2 Opposed surface elevations which are in close contact

Surface Smoothness of a Material in the Solid State. When mercury passes from the liquid to the solid state (at the temperature —40 C) the influence of surface-tension forces vanishes. The metal assumes a crystalline structure and the surface appears dull. This behavior is common to all metals. Glass, on the other hand, has an amorphous structure. The only significant difference between molten and solid glass is one of viscosity, and it might be expected that the surface of glass after solidification would exhibit the same degree of smoothness as when molten. This, however, is not the case. There are definite indications of the presence of both large and small-amplitude surface ripples presumably generated while the viscosity of the cooling glass was rapidly rising to its very high final value.

Surface-Finishing of Metals. No mechanical operation involving the removal or displacement of metal can result in the degree of smoothness automatically attained through the agency of surface-tension forces. It is equally impossible to match the surface geometry associated with the natural process. Johansson precision gage blocks exhibit what is probably (with metals) the highest attainable degree of dimensional accuracy and surface smoothness. In the case of blocks described as of AA quality the guaranteed dimensional deviation from a specified value is plus or minus 2 microinches per in. of length. Such small permissible deviations would not be possible unless the surfaces were very good with regard to flatness and smoothness.

The expression "very good," however, has little real meaning. It is certain that the processed surface of a gage block is covered with a multitude of tiny irregularities. It is reported that when two such surfaces are wrung together a force, in tension, of some 400 psi is required to separate them. The most reasonable explanation of this strong adhesion is that the tops of a very great number of opposed elevations are brought so close together that short-range molecular forces interact. In effect, when one such surface is made to slide over the other, exceedingly tiny metallic junctions or welds are rapidly formed and broken. The resistance to shear of each individual weld is very small but the aggregate shear strength as reflected in the value of sliding friction may be quite high. In use, the contacting surfaces of precision gage blocks are protected from damaging wear by a film of oil which need only be a few molecules in thickness. The dimensional accuracy of the blocks is not measurably affected by the presence of this film.

Ordinary shop methods of finishing fail to produce surfaces exhibiting the characteristic behavior of precision blocks when wrung together. It is proposed to inquire into the basic mechanism responsible for this difference. This can be done most easily by setting up a practical model of a close-contact system constructed to specification, and to predicate its probable behavior under specified conditions.

At the outset it is necessary to clarify the term "contact" by adopting definitions to cover two operating conditions:

(*a*) A bearing contact is one which, under equilibrium conditions, assumes its proportionate share of the normal load. The sum of the separate bearing-contact loads is equal to the applied normal load.

(*b*) A clean contact is one in which the native substrate material of opposed solid surfaces comes into molecular contact. The load at such a contact is increased by virtue of the interaction of surface atomic fields.

In what follows, the qualifying terms "clean," "true," "actual," or "real" as applied to areas of contact between opposed metal surfaces will be regarded as synonymous.

Practical Model of Friction System

Specification. Let the metal specimens be of heat-treated steel, ground, lapped, and polished to the best possible finish. Let each surface be overlaid with a monolayer of oriented molecules. Let the normal load be constant.

Apart from the terms of this specification the known facts concerning the mechanical and physical state of the specimens are:

(*a*) Between the free surface and the true crystalline body of the metal there is a disorganized zone containing highly stressed metal distinctly amorphous in nature.

(*b*) The immediate surface (Beilby layer) will be metal in the amorphous state.

(*c*) The free surface will be a continuous tarnish film usually of oxide, possibly in an amorphous state. Miscellaneous contaminants also may be present.

Topography of Surfaces. Departures from geometric flatness appear as surface waves of relatively large amplitude (pitch) and relatively small height above and below a geometric plane, while departures from geometric smoothness appear as a close pattern of tiny surface irregularities superimposed on the contours of the waves.

Conditions of Approach. In Fig. 2 the vertical scale of which has been greatly exaggerated, *M* and *N* represent the tops of two opposed elevations (waves) which have been brought together along the line of approach *X-Y* normal to the reference plane *A-B*. It is safe to assume that the waves on a polished surface are rounded in contour. This assumption has been adopted in the diagram. Also indicated is the presence of very small irregularities on the contours of the rounded elevations. There is a low probability that the elevations meet exactly "head on" which, in turn, implies a high probability that the planes of contact are randomly tilted with respect to the plane *A-B*.

Even when the utmost care is taken in the operation of bringing the surfaces together, it is extremely unlikely that the line of approach will exactly coincide with the line *X-Y*. Further, because of the presence of irregularities on the wave contours and because of the tilt of the

plane of contact, it is extremely likely that some degree of slip will occur at the moment of contact.

The statements and deductions following are based on the reported experimental findings of the following:

Bowden and Hughes (1939), Bowden and Tabor (1930), Bowden and Leben (1939), Finch, Quarrell, and Wilman (1935), Whitehead (1950), Parker and Hatch (1950), and Holm (1946).

Analysis. Pressures developed when very small irregularities on opposed surfaces are brought together under load may reach values far exceeding the elastic limit, thus causing surface flow of the material of the irregularities. The immediate result is disruption of the protecting tarnish film which travels with the displaced metal. What is even more important, the bonded oil molecules also travel with the flowed metal and none of the bonded molecules in adjacent undisturbed areas can move in. There is thus a very strong tendency toward the exposure of clean metal, the result being that molecular forces come into action at the exposed spots thus providing the ultimate reason for the creation of static resistance to relative tangential movement of the opposed surfaces.

In the model under consideration the process described for a single pair of opposed elevations is repeated at a great number of similar oppositions randomly distributed over the whole area common to both surfaces. It must not be assumed, however, that the effects occurring at all of the many oppositions are identical either in kind or in magnitude. Deformation pressures may vary widely as determined by the dimensions of the irregularities thus causing variations in the areas of clean metal exposed and, as a consequence, variations in the values of the molecular forces coming into action. In any event the measured value of static resistance to relative tangential movement of the opposed surfaces is the sum of the resistances developed at the individual contacts.

The question now arises as to the nature and order of magnitude of the resistances developed at the exposed areas. Let it be assumed, as is highly probable, that both the tarnish film and the film of oriented oil molecules originally present on both surfaces have been removed as a result of plastic flow at the contacting irregularities, thus permitting clean metal to come into molecular contact across the interface. The inevitable result is that a fusion or weld will be formed. Relative tangential movement will shear the weld. The force required is determined by the dimensions of the junction and the elastic constants of the metal. The strength in shear of an individual weld is very small but, since there are a large number of such tiny welds distributed over the com mon interface, the force required to shear them all (value of static friction) will be in the measurable range. The greater the total area of clean contact the greater will be the value of static friction. Two factors operate to increase the area of clean contact:

(*a*) An increase in the normal load leading to more extensive plastic deformation and surface flow.

(*b*) Improvement in surface flatness which tends to increase the number of contacts between opposed surface irregularities.

Following the argument it would appear that the flatness factor is mainly responsible for the difference in behavior of precision gage blocks and contacting surfaces finished by ordinary shop methods. It is to be recognized that it is only at or near the tops of opposed

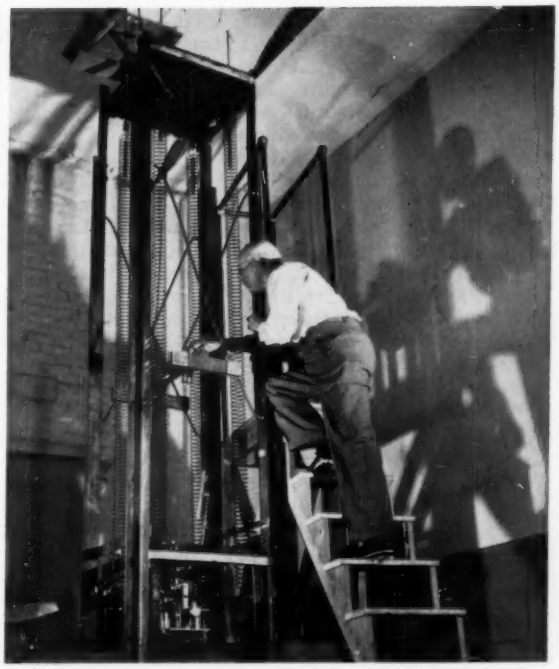

Fig. 3 View of Julius-type vibration-isolation suspension

elevations that clean contacts can be established. A reduction of surface waviness tends toward an increase in the number of close contacts made between opposed surface irregularities. Each of these close contacts is potentially a clean contact; i.e., a focal point for the generation of molecular forces, and the formation of a minute weld.

The Surface Film. Any discussion of frictional behavior in a close-contact system such as the practical model set up must take into account the important role played by the surface tarnish film, usually oxide, and its overlay of oriented oil molecules. It is fortunate that a protecting film is present, as otherwise, contacting metal surfaces in engineering practice would weld together immediately after relative sliding under load was initiated. Further, this disaster would not be averted by the presence of an oil monolayer bonded to the contacting surfaces, since such a film has the same physical properties and may be considered an integral part of the substrate. It is only when an oil film has a thickness of the order of 4 to 6 molecular layers (about $^1/_2$ microinch) that the constituent molecules have sufficient mobility to move onto suddenly exposed metal and thus afford some measure of insurance against the incidence of surface damage.

Bowden and Tabor, Holm, and others have shown that an increase in the normal load, by virtue of plastic deformation and surface flow, increases the area of clean contact and therefore the value of friction. It is evident that the presence of a surface film of oxide serves to set an upper limit to the ratio; actual/apparent area of contact. The tarnish film is a permanent feature in the interface. It may, under conditions of high rubbing load, be dislodged and even ground up into fine debris but it cannot be squeezed out.

In a previous paper[2] a sensitive friction tester was described. The normal load was 1 gram and the length of a rub track of a convex glass lens on a glass flat was of the order of a few thousandths of an inch. The instrument stood on a 40-lb cast-iron plate separated by a thick layer of absorbent cotton from a massive block of concrete built on bedrock. Among the materials tested was pure ricinoleic acid. It had been reported that under favorable conditions of exceedingly smooth surfaces the measured value of the static coefficient was "vanishingly small." This vanishingly small value had been attributed in part to the effects of mechanical disturbances. These may include a variety of superimposed elastic waves and rigid body movements at the contact point. The corresponding inertia forces may have relative components instantaneously additive to the applied tangential force and those instantaneously subtractive from the normal load, tending thus to initiate slip at lower apparent frictional coefficients.

In an effort to reduce the effects of incoming vibration to the lowest attainable limit a Julius-type suspension for the friction tester was designed (Fig. 3). A sensitive optical device capable of indicating mechanical disturbances at the contact spot of a fraction of 1 micron now gave negative results. Friction tests made after the installation of the vibration-isolation suspension now exhibited no abnormal behavior, thus confirming the view that "vanishingly low" static coefficients were referable to the disturbing effects of incoming vibrational energy.

Forced Vibrations. Additional confirmation was afforded by the use of a device by which forced vibrations were introduced into the system. This device embodied a disk driven at 100 rpm by a clock motor, and a 5-gram mass mounted on the disk with provision for varying its eccentricity from zero to 3 cm in steps of 0.5 cm.

Results

Fig. 4 is reproduced from a photographic record of a test made on ricinoleic acid before the installation of the Julius suspension, and shows, after a slip of 125 microns, an apparently vanishing value of friction.

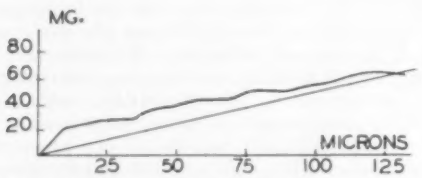

Fig. 4 Ricinoleic acid; graph from photo record before vibration isolation

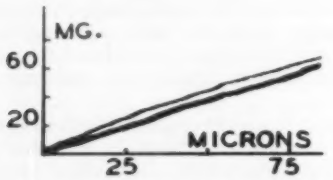

Fig. 5 Ricinoleic acid; original photo record. Imposed vibration: 5 grams at 3 cm eccentricity.

Fig. 5 is an unretouched photographic record of a similar test on ricinoleic acid after the installation of the Julius suspension, with the vibrator in place and with the weight set at an eccentricity of 3 cm. The introduction of a forced vibration, even of relatively low intensity, results in a friction graph showing a striking similarity to that in Fig. 4.

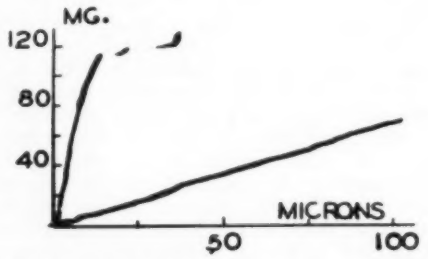

Fig. 6 Ricinoleic acid; original photo record. Weight eccentricity zero.

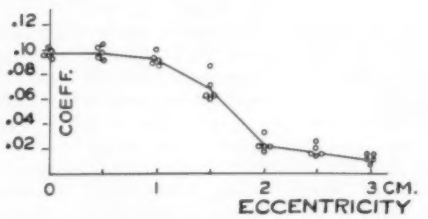

Fig. 7 Ricinoleic acid, effect of imposed vibration on static coefficient

Fig. 6 is an unretouched photographic record of an exactly similar test made when the weight eccentricity was zero. The slip was very rapid and its trace may not show in the reproduction.

Fig. 7. This is a graph showing the values found for the static coefficient of ricinoleic acid when the vibrator weight was set at $^1/_2$-cm increments of eccentricity from zero to 3 cm. The mean locus of the values is a smooth transition between two horizontal levels.

Conclusion

The fact that the graph in Fig. 7 is horizontal at the origin of the imposed inertia force suggests that extrapolation in the direction of lower intensities of mechanical disturbance than are maintained by the Julius suspension used, to the ultimate zero of mechanical disturbance, would then actually be the static coefficient of friction The coefficient measured appears to be very nearly this static coefficient.

Acknowledgment. The author wishes to express his very sincere thanks to Dr. H. Dean Baker, professor of mechanical engineering, Columbia University, for constructive criticism of the manuscript, and particularly for his most helpful interpretation of the experimental results reported in the final section.

He also wishes to thank D. D. Fuller, professor of mechanical engineering, Columbia University, for kindly reading the completed manuscript.

[2] "Further Developments in the Measurement of the Coefficient of Static Friction," by H. D. Baker, W. Claypoole, and D. D. Fuller, Proceedings of the First National Congress of Applied Mechanics, 1952, pp. 23–29.

A Review of Developments in

Plastics Engineering. . . . 1954-1955

At rate of expansion in plastics industry, six-billion pound market predicted by 1960

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ANY attempt to review developments in plastics engineering over the past year must be limited to high lights. Only those developments which appear to be most important and indicative of future trends can be included.

On several occasions during the past few years the statement has been made that developments in the plastics industry would not be in the form of new materials but rather in the modification of the existing materials and engineering techniques of fabrication and application. As is true of all generalizations there was some truth and some error in this opinion. There have been startling improvements in the older materials and important developments in the established methods of fabrication and application. But we also have had some new materials and new techniques of fabrication and certainly new applications.

Development of the Industry

In discussing the trends of the plastics industry as a whole it seems appropriate to start by reviewing the current production figures. In 1953 domestic production of plastics and resin materials (1)[1] was at the rate of 2776 million pounds per year and sold at an average price of 35 cents per lb. In 1954 this increased to 2827 million pounds selling at 34 cents per lb. During the first 6 months of 1955, production was at the annual rate of 3020 million pounds. An extrapolation of these figures could lead to a prediction of the production expected at some time in the future, but such a prediction perhaps can be better made by considering the trends and estimated markets of the future. Such factors as the changes in the age structure of our population and the increase in leisure time and home activities must be considered. After careful market analysis one estimate puts the 1960 figure at approximately 6000 million pounds (2).

An increase in the annual over-all production does not necessarily mean a general upward trend in all the various types of plastics. During the past 12 months phenolics and cellulose plastics have shown a somewhat decreasing rate of production. Polystyrene has remained fairly constant, while polyvinyl chloride, polyethylene and polyamides have shown a marked increase. It is anticipated that fluctuations in the demand for individual types of polymers will continue, and that some of the trends mentioned will be reversed.

[1] Numbers in parentheses refer to Bibliography at end of paper.

Contributed by the Rubber and Plastics Division and presented at the Diamond Jubilee Annual Meeting, Chicago, Ill., November 13–18, 1955, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Manufacturing Companies. The general growth of the industry has been accompanied by changes in the number and character of the companies in the field. New companies have been formed, older companies have merged, and several organizations have come into the plastics industry to diversify their interests. In some cases materials producers have started once again to produce finished fabricated articles and in a few cases materials fabricators have joined together to form companies to produce basic materials to have a positive source of supply.

In the equipment-manufacturing field many of the older companies have been sold to larger organizations during the past 12 months. Some people regard this trend as desirable since the new organizations may have more funds to use for research. Others feel that the character of the industry is such that the equipment needed can best be produced by companies specializing only in plastics.

Geographical Location of Plastics Industry. The geographical location of the plastics industry within the United States also has undergone a change during this period (3). Chemical production on the West Coast has increased 20 per cent with nearly every major manufacturer having at least one plant in this area. The plastics-processing industry, formerly centered around the East Coast and Midwest with a small amount in California has shown considerable growth in the Southeast and Southwest. The general trend is toward a more even distribution of plastics facilities throughout the country. Part of this change has been brought about by setting up of so-called captive fabricating plants where a supplier of consumer goods processes his own plastics components rather than using the facilities of the custom molder.

Foreign Developments. While these developments have been going on in this country great strides also have been made abroad. In Japan (4) national companies and foreign subsidiaries are producing at a rate of 180 million pounds per year. Most of this production is in vinyl polymers, cellulosics, phenolics, and urea molding compounds. German production increased 36 per cent in 1954, with a 50 per cent increase in material exported. A shortage of risk capital seems to be the only retarding factor. In South America, Argentina now produces phenolics and urea and plans have been approved to start production of polystyrene and polyethylene.

Engineering Developments. On the engineering side developments have been most encouraging during the past year but this is only a start. Strides have been

made toward a better understanding of the fundamentals of plastics fabrication and some progress has been made in reversing the trend toward overdesign of plastic components resulting from lack of engineering data. In the sections following some of these developments are reviewed which lead to well-engineered designs and operations and take full advantage of the unique desirable properties of plastics.

New Materials

Many new materials and new formulations of older materials were announced during the latter part of 1954 and the first 9 months of 1955. Space permits the mention of only the outstanding developments. Among the materials that have been on the market for some time which achieved added importance because of modifications are epoxy resins, silicones, phenolics, and polystyrene.

Epoxy Resins. Several new formulations of epoxy resins with desirable handling and curing characteristics have been developed. The developments in curing agents have made possible more applications of these materials in impregnation, surface coating, and adhesives. The good flow characteristics and dimensional stability permit precision castings.

Silicones. The high heat-resistance characteristics of the silicones (5) have always made them of interest to the engineer. Recent steps toward improving the molding characteristics and better formulations of fillers have improved the applicability of these materials.

The phenolics, at one time the backbone of the industry, also have shown some development. Glass-filled materials with improved molding characteristics are now on the market. Formulations with better cure times have increased production cycles.

Styrene Copolymers. Styrene copolymers, blends, and alloys have increased the number of materials available with tailor-made properties. Proper proportioning of acrylonitrile, butadiene, and styrene in the copolymer leads to a desired balance of properties (6). Expandable styrene molding compounds have brought about new applications.

Ethylene-Glycol Film and Tape. The polyester formed from the condensation of ethylene glycol and terephthalic acid (7) has had a revolutionary impact on the film and tape fields. This product, although first announced some time ago, came into its own during the past year. Exceptional toughness over a wide temperature range combined with interesting decorative effects indicate many applications for this material. Of interest to the engineer are the desirable electrical properties of this material. Price reductions have been announced as a result of greater production.

Nylon. The growing acceptance of nylon as a mechanical-engineering material (8) has led to increased application and new formulations. Gears, cams, pulleys, levers, and bearings are examples of mechanical components made from these materials. The caprolactam-type nylon is now manufactured in this country and has found wide acceptance. As the volume has grown, price reductions have appeared.

Isocyanate Resins. The great interest in the polyurethane (9) or isocyanate resins has centered around their use as foams, wire coating, paints, and adhesives. The foams may be made either extremely soft or very hard. One manufacturer estimates there is a market for 100 million pounds annually of foamed polyurethanes. Good adhesion, low thermal and acoustical transmission, and low density make this material desirable as a foamed-in-place filler for aircraft and sandwich-construction applications. The unusual recovery from deformation characteristics of this material make it useful in impact-absorbing applications. Encouraging more uses for this material has been a reduction in price of the diisocyanate from $2.60 to $1.20 per lb during the year.

Ethylene Polymers. Perhaps the most interesting developments in materials during the past year has been in ethylene polymers. Three developments coming almost simultaneously have caused rumor and speculation to run wild: (*a*) The appearance on the market of products made from irradiated polyethylene. (*b*) The announcement of large increases in the polyethylene production capacity of the country by both new and older producers of the material. (*c*) The announcement of the so-called low-pressure polyethylenes to be produced by two different methods.

Controlled irradiation (10) has been used to produce essentially cross-linked polyethylene molded items and tapes. The rigidity is increased and the upper-use temperature limit extended. The technological problems of irradiating large quantities of varied-shape articles has been a stumbling block to this development but some producers believe this can be solved. Numerous finished products of this material have been exhibited. Tape for electrical uses of irradiated polyethylene standing continuous operation at 105 to 125 C has been produced.

High-Pressure Polyethylene. The vast increases in the production capacity in the country for high-pressure polyethylene (11) has been one of the most important developments. Present capacity is estimated now at about 475 million pounds per year. It is expected that as announced new units come on line, capacity will increase to around 600 million by 1957. The statement is often heard that polyethylene will be the first billion-pound plastic. The prediction that polyethylene would be in over-supply as capacity increased has been tempered by the development of new markets and new applications plus the delay in some cases of getting the new units into production of top-quality material.

Low-Pressure Polyethylene. On top of this expansion in production of high-pressure polyethylene has come the long-awaited announcement that facilities are under construction to produce low-pressure polyethylene by two different processes (12). This more rigid polyethylene exhibits a higher modulus, greater heat resistance, and lower permeability than the conventional material. Neither process requires high pressure for the polymerization. The resulting polymer, described as being more linear and more crystalline, has a higher density than the conventional material. It is generally felt that this new material will broaden the possible applications of plastics and make inroads into the present market of several materials besides conventional polyethylene.

Questions still unanswered which cause very active speculation are: Do both processes give the same product? What is the potential market for these materials? Will the new materials be cheaper than high-pressure polyethylene? Is it possible to make this material by still other processes?

Propylene and Styrene. Finally an important development announced in the spring of 1955 deserves careful attention. By the use of new heterogeneous catalysts in a process similar to that used with low-pressure polyethylene, other highly crystalline polymers have been

prepared (13). The isotactic polymers of propylene and styrene have received the most study to date but many others can be made. The higher-use temperatures of these materials make them of particular engineering interest.

New Processes of Fabrication

The developments in the methods of fabricating plastics have been toward better control, better engineering, and reduction of time in the fabricating cycle.

Injection-molding quality and speed have been improved by several developments. The use of hot runners or runnerless molds, balanced gating, and careful control of pressure have lowered costs and increased production rates. Several automatic high-speed machines have come on the market. The accurate control of temperature and cycle has led to marked improvement in quality.

Extruder Performance Improved. Extruder performance has been improved by increased understanding of the correct engineering design of the screws and better temperature control. Increased production by this method also has resulted from better quality control of the raw materials. A larger proportion of extruding capacity is now being used for the production of flat sheets and films. Several producers are vacuum-forming directly on the hot extruded sheets.

Calendering continues to hold its own in the production of sheet material especially where continuous embossing is desired. Methods have been devised for continuous polishing of sheets and films (16).

Vacuum-Molding. Vacuum-molding processes have become more popular with the availability of several well-engineered models of equipment on the market. The economics of vacuum-forming versus injection-molding has captured the interest of the engineer. Many factors including the number of items to be produced as well as the size and shape must be considered. It must be concluded that each method has its advantages but it is often difficult to decide which one to use.

Mold-Making. Interesting developments have taken place in the mold-making field. For short-run and medium-production jobs, phenolic and epoxy molds have been developed with good dimensional control and wear resistance with considerable economy. In the field of metal molds, aluminum has found popularity for vacuum-forming together with many metal-plastic compositions. The production of electroformed molds has resulted in economies and great reproduction of detail.

New Products

Through new knowledge of the engineering of plastics new products have been developed. Through better engineering, improvements have been made in older products.

Developments in reinforced materials have led to many new structural applications. Sandwich materials made with aluminum or impregnated canvas or paper honeycombs have become more important as engineering materials in the transportation, packaging, and building fields. The high strength-to-weight ratio and the relative ease with which they can be fabricated predict that these materials will be found in many future applications. Doors and other prefabricated panels for the building trades are now on the market. Data for the engineering design of these composite structures is being developed.

Glass-Reinforced Products. In the glass-reinforced field several developments are worthy of mention. Moldable reinforced sheet which can stand fairly deep draws has simplified the fabrication of many items. Increased use of epoxy resins in new composite materials has improved aging properties. The use of fine flat-glass scales as reinforcing has been started and may lead to very interesting applications.

Swimming pools constructed of reinforced-plastic sections have made deeper inroads on this market. Such developments are attractive from several viewpoints, particularly the reduction in labor at the site.

Plastics Tools. From the engineering point of view, the progress made in plastics tools for the metal-forming industry is one of the most important events of the year. The economies brought about and the speed with which jigs and fixtures can be made have brought the impact of this new technology to all parts of the fabricating industry. Polyester glass, epoxy, cast phenolics have all played a part in this development. Savings up to 50 per cent in cost of dies have been reported.

Plastic Pipe. Among the important engineering applications of thermoplastics is their use in plastic pipe. The corrosion and chemical resistance of these materials have led to the development of a whole line of pipes and fittings. There is a current trend for the metal-pipe manufacturers to take advantage of these desirable properties by developing plastic-lined pipe. Experimental work is going on in the use of plastic pipe in household plumbing and one town has an entire plastic water-supply system.

Decorative Plastics. Wall coverings and ceilings have become a large outlet for vinyls. Thin sheets with interesting colors and embossed or vacuum-formed patterns have found wide application in new construction. The development of calendering styrene materials will give added emphasis to this field. Light-diffusing panels add still more uses in the home-building area. Suspended ceilings of corrugated thermoplastic sheets have found acceptance in office and industrial buildings.

Automotive Applications. The automotive field continues to find more application for plastics as engineering materials. Truck bodies and convertible roofs have now been made of reinforced polymeric material. It is estimated that 56 million pounds of molding materials have gone into automobiles during the past year.

Finally, one application of plastics which shows unusual creative-engineering thinking is worthy of mention. That is the use of tiny microballoons of phenolic floating on the surface of oil in storage tanks. This process is expected to eliminate 80–90 per cent of the evaporation.

Education, Publication, and Professional Activities

The need to increase and improve our knowledge of plastics engineering is self-evident. One bad misapplication of plastics and the whole industry suffers. If we are to guard against misapplication we must learn more about the properties of plastics and develop engineering-design and application techniques. The problems of the design and operation of plastics-fabricating equipment are just beginning to be studied using fundamental engineering principles. The activity in the

(Continued on page 540)

Professional Standards and Employment Conditions

A Report of Engineers Joint Council

Unlike the members of most learned professions, the engineer usually is an employee rather than a private practitioner. Surveys indicate that about 80 per cent of professional engineers are in the employee classification, and this situation sometimes creates special problems which are not inherent in the other professions. One such problem is how specifically to create and maintain an employment atmosphere consistent with high professional standards. Certain conditions of employment have had a profound influence on engineers and, among other factors, have caused a number of professional employee groups to turn to collective bargaining. There is a need, therefore, for the engineering profession to state clearly the employment conditions that engineers expect as professional men. Employers should align their policies with respect to the engagement of professional-engineering personnel to meet these expectations. Mutual understanding between employers of engineers and the engineering profession is essential to the establishment of an environment which will encourage the individual engineer to achieve full professional stature. A special committee of Engineers Joint Council was charged with a study of this employment problem and the preparation for Engineers Joint Council of "a means of education of and vertical communication to the membership of the constituent societies (including students) concerning conditions surrounding unionization of professional personnel." Another assignment of the special committee was the preparation of information for employers of engineers concerning employment practices, educational opportunities, and general measures for professional development that influence the attitudes of engineers toward a true professional outlook. This study treats but one of the many problems confronting the profession. Engineers Joint Council will continue its study of the problems related to the employed engineer. [The report, slightly condensed, follows.—Editor.]

The Present Situation

The expansion of engineering from its beginning in military and civil engineering a century ago to a multiplicity of disciplines today has created a host of problems. Of major concern to the engineer is his relationship as a professional man with his employer. This relationship is influenced largely by employment conditions including salaries, training programs, security policies, levels of responsibility, job classifications, and identification with management.

Because the needs, responsibilities, and contributions of professional employees have not been recognized adequately, in some instances there has been a movement toward the unionization of engineering personnel. This has had an adverse effect on the professional concepts of many engineers, for a professional man must rely first on his own personal competence and integrity for recognition. In addition, confidential relationships which should exist between employers and professional engineers have been jeopardized.

The fact that there has been a trend toward collective bargaining by engineers, in spite of widespread reluctance to participate in such action, indicates the existence of unsatisfactory conditions. The engineering profession and management have a great stake in the solution of the problem and the latter must accept its share of the responsibility for alleviating unfavorable employment conditions.

Causes of This Condition

Reasons which have fostered collective bargaining among engineers have been studied and may be grouped as follows:

Professional Treatment

(*a*) A feeling among engineers that they were not identified with management, whether they were employees in industry, private engineering firms, or public service.

(*b*) Inadequate channels of communication between top management and nonsupervisory engineers.

(*c*) Inadequate recognition of the engineer as a professional employee.

(*d*) Assignment of engineers to subprofessional work.

(*e*) Undue retention of engineers in specialized and narrowly compartmentalized assignments.

(*f*) Lack of appropriate means for resolving individual problems.

Personal Treatment

(*a*) Inadequate recognition and treatment of the engineer as an individual.

(*b*) Lack of broad position classifications and appropriate titles by which the engineer could measure his progress.

(*c*) Inadequate or nonexistent plans for training and job rotation.

(*d*) Inadequate understanding of promotional policies and belief that progress and promotions were not commensurate with ability and performance.

(*e*) Feeling of insecurity of employment.

(*f*) Management's human relations knowledge and skills have not kept pace with the expanded utilization of engineers.

Financial Treatment

(*a*) Engineering salaries not commensurate with fundamental contribution.

(*b*) Too small a differential between the pay of engineers and members of the skilled trades.

(*c*) Salaries of experienced engineers not sufficiently increased, in comparison with present starting salaries.

(*d*) Wide variation in salaries paid to engineers doing comparable work in different organizations.

(*e*) Dissatisfaction with merit review systems and inadequate understanding of salary administration.

Faced with these conditions, some engineers have resorted to unionization in the belief that corrective action could be effected only by pressures on management through collective bargaining. Even though they may have realized that professionalism requires freedom of action, these engineers appear to have been willing to submerge this principle in their attempt to get more pay and better working conditions through union activity.

Summary of Historical Background

The accelerated development of mass-production techniques in this century stimulated a rapid rise in labor-union activities. Labor and management faced common problems of increasing complexity. In 1935 the United States Congress enacted the National Labor Relations Act, better known as the Wagner Act, which guaranteed to employees the right to organize and to bargain collectively and protected labor unions against specified unfair labor practices on the part of management. At that time there was little realization on the part of the professions of the potential impact of the Wagner Act on professional employees. However, the established labor unions soon took advantage of the situation and it was not long until many professional employees found themselves included, against their individual desires, in heterogeneous bargaining groups.

Some engineering societies, particularly the American Society of Civil Engineers, undertook to chart a course of action designed to assist professional employees against inclusion in heterogeneous groups. At first, the effort met with but minor success. Later, Engineers Joint Council determined to present its views to Congress with the hope that the Wagner Act might be amended to provide recognition of the status of professional employees and to enable them to act effectively on their own behalf. Pertinent clauses were included in the Labor Management Act enacted by the Congress in 1947—better known as the Taft-Hartley Act.

Of interest to the engineering profession, this law specifically provides under Section 9 (b):

"The Board shall decide in each case whether, in order to assure to employees the fullest freedom in exercising the rights guaranteed by this Act, the unit appropriate for the purposes of collective bargaining shall be the employer unit, craft unit, plant unit, or subdivision thereof; PROVIDED that the Board shall not (1) decide that any unit is appropriate for such purposes if such unit includes both professional employees and employees who are not professional employees unless a majority of such professional employees vote for inclusion in such unit...."

The term *professional employee* as included in the Act reads

"(*a*) Any employee engaged in work (i) predominantly intellectual and varied in character as opposed to routine mental, manual, mechanical, or physical work; (ii) involving the consistent exercise of discretion and judgment in its performance; (iii) of such a character that the output produced or the result accomplished cannot be standardized in relation to a given period of time; (iv) requiring knowledge of an advanced type in a field of science or learning customarily acquired by a prolonged course of specialized intellectual instruction and study in an institution of higher learning or a hospital, as distinguished from a general academic education or from an apprenticeship or from training in the performance of routine mental, manual, or physical processes; or, (*b*) any employee who has (i) completed the courses of specialized intellectual instruction and study described in clause (iv) of paragraph (*a*), and (ii) is performing related work under the supervision of a professional person to qualify himself to become a professional employee as defined in paragraph (*a*)."

Under the Taft-Hartley Act a group of professional employees in any place of employment may decide by majority vote of their own numbers whether they want to form a unit of their own for collective-bargaining purposes, to join with some other bargaining group, or to refrain from collective bargaining entirely.

It was hoped that the amended act would provide a satisfactory solution to the inclusion of engineers in heterogeneous unions. Professional employees could dissociate themselves from heterogeneous groups. It was not expected that employees of professional status ever would desire anything like a nation-wide bargaining union. It was hoped that labor unions would respect the statutory rights of professional employees.

Those hopes today lack much of full realization.

A number of bargaining groups of professional employees have come into existence. Some appear to have functioned constructively; the same hardly can be said of others. Already there is a nation-wide union, self-designated as an engineering union, which aspires to power. Although some professional employees have been able to disassociate themselves from heterogeneous groups, craft unions, particularly in the construction industry, are forcing more and more engineers into their ranks by bringing economic pressure upon employees, thus avoiding the election machinery of the Taft-Hartley Act. Clearly, many members of the engineering profession and employers of engineers are not doing enough to insure enforcement of the letter and spirit of the law.

The recent merging of the American Federation of Labor (AFL) and the Congress of Industrial Organizations (CIO) brings into being a large and powerful labor organization among whose objectives are increased efforts toward unionization of office employees and technical personnel. That effort will have direct impact on professional engineers.

To obtain reliable statistics regarding the current status and thinking of a cross section of the engineering profession, four constituent members of EJC, namely,

ASCE, ASME, AIEE, and SNAME, polled 117,917 of their members on specific questions concerning collective bargaining. Of those polled 66,938 or 57 per cent, responded.

Returns showed that 48,082, or 72 per cent, of the 66,938 respondents opposed collective bargaining for professional engineers, and that 44,168, or 66 per cent, felt that collective bargaining is incompatible with professional status.

Further, the 66,938 responses showed that less than 4 per cent were actually members of established collective-bargaining groups; 27 per cent reported as not being opposed to collective bargaining; 20 per cent reported that they believed collective bargaining would be advantageous to them; and finally, less than 1 per cent of the membership of three member societies (the fourth did not ask the question), would prefer to be represented by a craft labor union.

These results present a challenge to the engineering profession and to engineering management. The thinking of the remaining 43 per cent of the 117,917 members polled, who did not respond to the questionnaire, is still unknown, but, assuming that the sample was representative, there would then be 30,300 members not opposed to collective bargaining for professional engineers.

These results emphasize the situation confronting the profession in spite of the protective clauses in the Taft-Hartley Act.

Statement of the Problem and Suggested Solutions

A summary of the foregoing might lead to two basic reasons for the present situation:

1 Engineers have not always realized and understood the professional characteristics of their roles.

2 Management has not always realized and accepted its obligations to engineers.

If these are the causes, the problem then may be stated as how to get the engineer to appreciate the professional characteristics of his position and how to get management to realize and accept its obligations to its engineers.

Immediately certain solutions present themselves, and these may be listed under five main headings:

1 Point out to the engineer and re-emphasize to him that engineering is a profession and that he therefore has certain definite responsibilities.

2 Point out to management, through all feasible ways, that it has responsibilities to the engineering profession.

3 Point out to professional societies the part which they should play in the advancement of their profession.

4 Point out to engineering educators their responsibilities for developing professional concepts in their students.

5 Point out to society the contribution of the engineer to its general welfare.

Engineering—A Profession

Engineering is the art and science by which the properties of matter and energy are made useful to man in structures, machines, and products. Accomplishment of these ends requires not only scientific training, but also creative imagination, judgment, and an appreciation of the economics involved. The work of the engineer is predominantly intellectual and varied. The dictionary defines engineering as a mental activity rather than a manual skill. The engineer must exercise discretion and judgment, he must wish to serve, and his relationship with management must be one of confidence; in fact he is part of management.

The engineer's code of ethics requires that "he will have due regard for the safety of life and health of the public and employees who may be affected by the work for which he is responsible" and that "he will act in professional matters for each client or employer as a faithful agent or trustee."

Since clients and employers usually do not have the technical knowledge necessary to judge technical work, the engineer is bound to place their protection above his personal convenience or his immediate personal gain.

The work of a truly professional engineer is so far from a routine established pattern that only he can provide the initiative, the discretion, and judgment to achieve the successful accomplishment of his particular tasks. Because he alone knows with what comprehension, ability, and likelihood of success he approaches his assignment, the professional must accept individual responsibility or else advise his client or employer that other help is needed.

Professional attitude involves the following five basic concepts:

1 A social consciousness, a desire to contribute *to* rather that simply to benefit *from* civilization; a resolve to place the public welfare above other considerations.

2 The acquisition of special skills on a high intellectual plane, generallly evaluated by means of self-imposed standards of excellence.

3 A sense of trusteeship—personal responsibility to protect the client's or employer's interest.

4 Individual initiative and acceptance of individual responsibility, both of the highest order.

5 A right to expect and to receive adequate financial recognition.

Prestige, however, is something that must be won. It cannot be bought or automatically accorded through affiliation with an organization. It is something that one can *command* but never *demand*. In the final analysis, an engineer achieves professional standing only to the extent that he accepts his responsibility to himself, to his client or employer, and to society.

Attainment of a degree in engineering from an institution of recognized standing implies that the graduate has mastered a certain curriculum and that he has the ability to understand, to assimilate, and to apply the knowledge that qualifies him to become a member of the engineering profession.

Employee's Responsibility

"As an engineer, I will participate in none but honest enterprise. To him that has engaged my services, as employer or client, I will give the utmost of performance and fidelity." (*Faith of the Engineer*)

The engineering employee is bound by the same ethical and moral principles that apply to a member of any other learned profession. The responsibilities of an engineering employee are many. He is obliged to perform the professional assignments entrusted to him to the best of his knowledge and ability. He should give needed professional counsel in his special field and render loyal service. He should respect the economic problems

of his employer. He should be thorough, expeditious, original, and accurate in the execution of his duties and assignments. He should have a rational attitude toward his work and fulfill each task with a minimum of supervision. At all times he should strive to improve the quality and increase the quantity of his output.

Education is important to the engineer and he should foster its continuance for those who are subordinate to him. He should strive to recognize and to utilize the diverse capacities of all fellow employees. He should strive for good planning and clear concise reports. He should be friendly and maintain a good appearance. He should develop the ability to be a good listener as well as to express his thoughts effectively.

Any employee who is unwilling to assume responsibilities beyond those accompanying his present job has little right to be critical about lack of advancement. If he feels that he is not getting earned recognition, it well may be that critical self-appraisal is in order. One cannot just wish himself up the ladder or depend on someone else to push or pull him along the way to success. The fact that a man has acquired a bachelor's degree in engineering does not, of itself, entitle him to any lasting professional recognition. It remains for each individual to prove by his own ability, integrity, and conscientious application to duty that he deserves recognition.

Management's Responsibilities

Surveys show that more than 40 per cent of management were trained as engineers. It seems illogical, therefore, that often there is inadequate communication between management and engineers with consequent lack of understanding on the part of management of the reasons for dissatisfaction among professional employees.

Management must recognize the inherent professional character of engineering work. It should be a policy of management to use its professional employees to the maximum of their capabilities. Except during the training period the engineer should not be assigned to tasks which do not require his technical training and he should be accorded individual and professional status commensurate with the quality of his contribution.

There must be opportunity for a continuation of education. It is important that professional employees be given opportunities to participate in activities of scientific and technical societies. It is important that they receive credit for their contributions to the advancement of technical knowledge or the profession as a whole.

There must be adequate communication between management and the professional employee. There should be organized orientation and training programs for new employees. Engineers need to understand the basic policies of their employer. They need to know their responsibilities and their opportunities for advancement. Adequate management-employee communications require a day-to-day relationship supplemented by periodic performance reviews, and other appropriate techniques.

Salaries must be established which will recognize the contribution of the professional employees as related to that of other groups. Salary differentials between various levels of technical experience have been substantially narrowed during recent years. Engineers who, after a period of satisfactory employment, find their salaries are only slightly higher than those of the recent graduate and possibly lower than those of a skilled craftsman are not working in a favorable atmosphere.

Management must minimize the fear of job insecurity by adopting feasible means for stabilizing the employment of professional personnel and suitable termination policies. Since many engineers become managers, there is a need to insure that they are employed and developed in an atmosphere which will fit them for their future responsibilities. Executive talents must be developed by experience and training in those phases which lead to managerial responsibilities.

Engineers Joint Council recommends that

1 Management utilize the services of engineers more effectively and thereby afford them opportunity for advancement and economic improvement.

2 Management recognize its responsibility to make engineers feel that they are a part of management.

3 Management survey areas of communication, recognition, and salaries and, where found wanting, correct to conform with standards of professional practice.

4 The engineer take inventory of his services and his actions to make sure that he has a professional attitude toward his work.

5 Engineering societies establish and employ appropriate means to maintain high standards of ethical conduct for professional achievement.

6 Engineering societies encourage the professional development of their members and promote proper recognition of the profession.

7 Engineering educators emphasize the characteristics of the profession.

Engineering Societies' Responsibilities

The engineering societies must take the lead in the advancement of the profession. Among the basic responsibilities of the engineering societies are the establishment of standards of ethical conduct, rigid requirements for admission to membership, accreditation of educational institutions which grant engineering degrees, and awards and prizes in recognition of worthy contributions to the advancement of the profession.

Current efforts of national committees to encourage professional development of engineering-society members and to promote recognition by the public of the professional character of the engineers' work should be expanded. An objective evaluation of the problem should be continued, followed by specific recommendations for the good of the profession. Engineering societies should adopt official statements for membership information with respect to collective bargaining to the

extent permitted by their charters and constitutions. They should acquaint their memberships with those provisions of the Taft-Hartley Act which have a special significance to professional engineers. Constructive programs for encouraging professional consciousness on the part of engineers both before and after graduation should be sponsored. Therefore, the engineering societies and Engineers Joint Council should inform management as to the standards that will contribute to full professional achievement.

The engineering societies should provide guidance and assistance to educational institutions confronted with any problem which is detrimental to the achievement of full professional training of students.

Engineering Education's Responsibilities

Engineering colleges have a primary responsibility for developing professional concepts in engineering students. Professional concepts should be developed through their application to the solution of engineering problems in the technical courses, lectures, association with students, and by good example.

Opportunities for engineering educators to become better acquainted with the total environment in which engineers work should be expanded through temporary employment in nonacademic fields and the utilization of employers with "professional vision" in the classrooms and student seminars. Such activities enable students to appraise their status more realistically upon graduation.

Conclusions and Recommendations

There are obligations and responsibilities resting on both employer and employee. Each, of course, has responsibility to advance his own welfare. Beyond that, and yet a part of it, each has responsibility to the other and to society. Grave responsibilities for inculcating and developing professional consciousness in young members of the profession rest upon the educational institutions and professional societies. Various phases of such responsibilities have been stressed in the several sections of this report.

Without a sound technical foundation no man can become a competent engineer. But more than technical competence is demanded of one who expects to be recognized as a professional person. One must understand and observe appropriate ethical standards and it is important to cultivate proper understanding of such standards.

The ECPD program "The First Five Years of Professional Development" is an excellent step in the right direction. Here is opportunity for the engineering societies, the colleges, industrial management, and civic institutions to work together to aid young graduates in continuing their education and in adjusting themselves to conditions to be met in the practice of their profession.

The present report has been prepared with full realization that the subject refers chiefly to one phase of professional life. An attempt has been made to identify factors that have significant bearing on the specific problem under consideration. Concerted efforts by all concerned with advancement of the profession are required if satisfactory solution is to be found. It is believed that if the recommendations submitted are followed by those to whom they are directed, substantial improvement in the standing of the profession will result.

Review of Developments in Plastics Engineering, 1954–1955

(*Continued from page 535*)

chemistry and physics of polymers has brought out many fundamental principles on which the engineering of plastics should be based. It is our job today to put these principles into our engineering.

Toward this end we must increase our plastics education, publication, and professional activities. In the field of education, Princeton University has presented a graduate program in Plastic Engineering for the past 10 years. During the past year Lowell Technological Institute and the Newark College of Engineering have initiated plastics-engineering courses at the undergraduate level. The industry needs many more men with this training than these schools can graduate and must promote similar programs in other schools.

Publications dealing with the engineering of plastics have been increased this year by the addition of *Plastics Technology*, a magazine of applied engineering. The number of pages on polymers in the scientific journals indicates the growing importance of these materials.

In order to assist in the dissemination of engineering knowledge and to develop an improved technology, both Germany and Holland have set up national plastics institutes to carry on research and provide assistance to the industry. It has been suggested several times during the past year (17) that this country should have a similar organization.

The primary objective of such an institute should be the accumulation and dissemination of engineering data on all plastic materials. Surely such an information agency is necessary in view of the growth in number of materials and engineering of processing methods but whether or not this development should come in the form of a national plastics institute or from greater activity in the plastics-engineering societies and divisions deserves serious thought.

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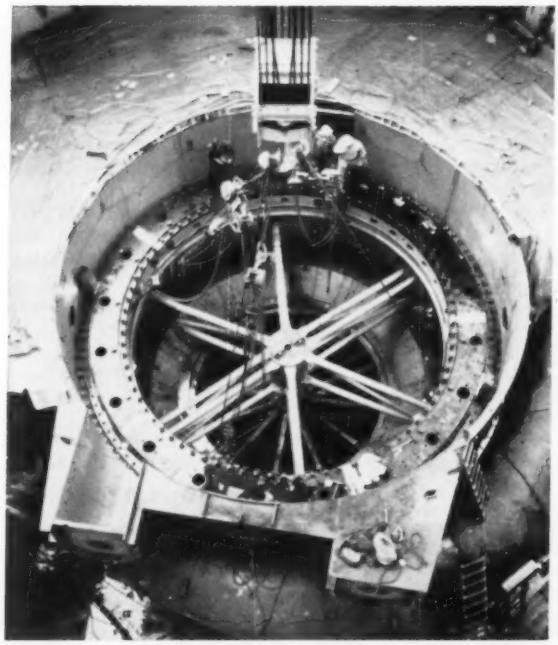
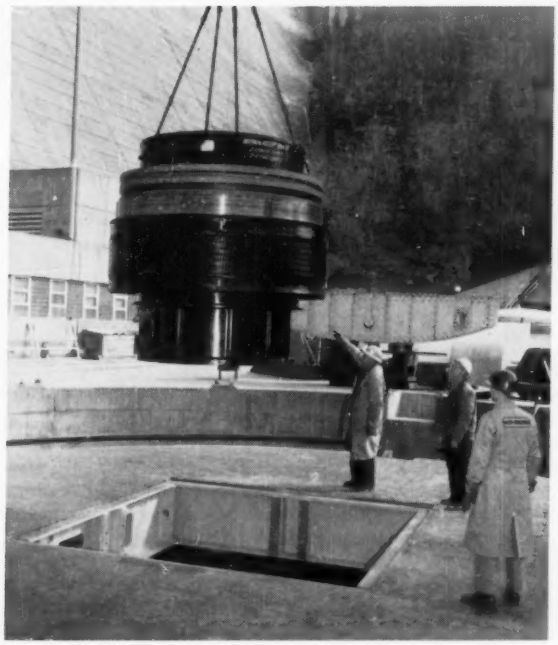
Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Associate Editor*



Lowering outer-cover ring for world's largest pump-turbine unit at Hiwassee Dam into turbine pit



Exciter rotor about to be lowered through an exciter bridge for attaching to the rotor of the motor-generator

Reversible Pump-Turbine Unit

THE world's largest reversible pump-turbine unit, designed and built by Allis-Chalmers Manufacturing Company for TVA's Hiwassee Dam in southwestern North Carolina, is the heart of a unique plan for storing large blocks of power. This is the first installation in the western hemisphere of a reversible pump-turbine for the initial purpose of helping to level system load curves. See frontispiece, page 504 in this issue.

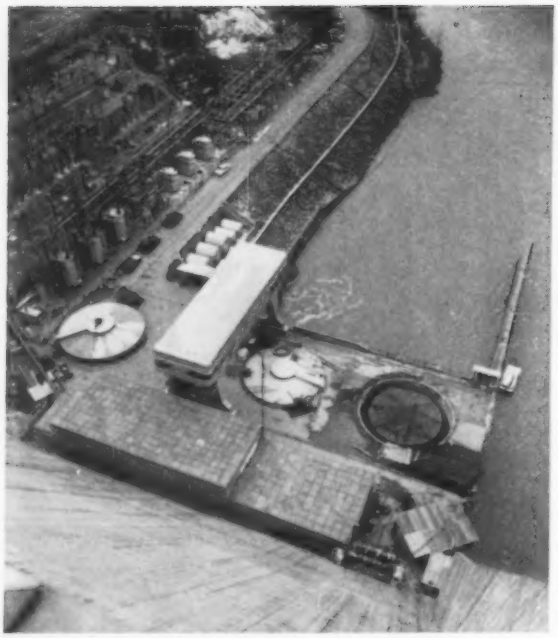
Electrically, this dual-purpose machine is rated 70,000 kva as a hydraulic turbine-generator and 102,000 hp as a pump-driving motor—the world's largest by more than 20,000 hp. Hydraulically, it is designed to generate 80,000 hp under 190-ft head—to pump 3900 cfs against 205-ft head. Rotation is clockwise for generating, counterclockwise for pumping.

In pumped-storage systems the reversible pump-turbine unit, developed by Allis-Chalmers, can generate electric power to help meet peak day-time demands, drawing on water stored for that purpose. In off-peak night-time or week-end hours, the supply of available electric power exceeds the normal demand. The machine can then be motorized to pump water back into the storage reservoir. It is, in effect, the means by which surplus electrical energy can be converted to water power, stored, and reconverted when needed to fill electric-power requirements. With the large reversible pump-turbine units, approximately 3 kw can be generated for every 4 kw used for pumping. The Hiwassee unit will assure maximum plant capacity during seasonal peak-load periods when water level is normally low.

In addition to being the world's largest pump-turbine, its 266-in. Francis-type runner is larger in diameter than any other. The electrical component, rated 102,000 hp as a motor, has no equal. If the full pumping capability of the unit were utilized over a 24-hr period at lower than rated head, it would lift more than three-and-a-quarter-billion gallons of water—three times the average daily requirement of New York City.

Although it is a relatively new concept, components of the reversible pump-turbine are little different from those already incorporated in many vertical hydroelectric machines. The pivoted shoe-type thrust bearing, for example, is inherently suited for reversible operation. That for the Hiwassee machine supports a total of 1,365,000 lb.

To reduce breakaway torque in start-up, both for



Over-all view of Hiwassee Dam. Pump-turbine partially assembled with tarpaulin for protection is *at right.*

motoring and generating, thrust bearings for reversible units are fitted for high-pressure lubrication. The high-pressure system operates in the starting cycle, establishing a film of oil between thrust bearing surfaces so effectively that one man can readily start the Hiwassee machine rotating by pushing against an arm of the rotor spider. This system is in use on very large hydro-generator installations, as well.

The pump-turbine runner is similar to the Francis-type turbine runner in design, but is modified for high efficiency as pump and turbine. Hydraulic control of the Hiwassee unit is by means of movable wicket gates.

Variations between the unit's electrical characteristics and those of a typical hydraulic turbine-generator are chiefly due to its dual purpose as generator and motor. Ratings are 102,000 hp, 95 per cent power factor, 80 C rise, 13,500 volts, 135.9 rpm as a motor; 59,500/68,425 kw, 70,000/80,500 kva, 60/80 C rise, 85 per cent power factor, 105.9 rpm as a generator.

A ring of 20 adjustable wicket gates controls the flow of water to the unit's impeller runner for power generation, and likewise regulates the flow of pumped water for greatest efficiency. When starting as a pump, the wicket gates are closed and a compressed air blow-down system dewaters the runner. This reduces motor-starting torque requirements and eliminates system disturbances. Reduced voltage starting limits current in-rush below normal load. The motor is then started and brought up to speed. Release of air pressure allows the water level to rise in the impeller, the wicket gates slowly open to the proper setting, and water flows up the penstock into the storage reservoir. Much the same sequence, in reverse, is followed at the end of the pumping cycle. For power generation, the unit is started in the same manner as a conventional hydraulic-turbine unit.

Liquid-Metal Pump

THE atomic equipment department of Westinghouse Electric Corporation has developed a new hermetically-sealed mechanical liquid-metal pump. Designed to circulate liquid sodium and sodium potassium alloy, it can be applied in nuclear power plants, chemical process lines, and for other applications requiring high-temperature heat-transfer mediums. It is available in capacities up to 5000 gpm for fluid temperatures as high as 1600 F.

There are no external shaft seals in these pumps, and suction and discharge nozzles are designed to be welded into the pipe line. Although the pumped fluid is allowed to fill the motor cavity, it is excluded from the rotor and the stator windings by sealing jackets in the magnetic gap.

All surfaces in contact with pumped fluid are made of corrosion-resistant alloys—austenitic stainless steel and Inconel.

An external supply of coolant is the only auxiliary requirement. Double walls are provided between the coolant and the sodium at all points of the integral heat exchanger.

The bearings, lubricated by the pumped fluid, are made of sintered carbides to withstand the corrosive effect of sodium. Good lubrication is assured by keeping the temperature of the sodium, in the region of the bearings, between 275 F and 400 F regardless of the temperature of the pumped fluid.

To provide for thermal expansion, a unique "thermal-flex" mounting system has been applied to the radial

New high-temperature mechanical liquid-metal pump has high efficiency and is comparatively small in both size and weight

Hydraulic pipeline dredge designed for operation on jobs requiring maneuverability and small size

bearings. Supported from the mid-points of a series of leaf springs, the bearings are self-aligning.

A new regenerative-type cold trap is used that reduces to below 0.001 per cent the sodium-oxide particles that pass through the motor and bearings. The trap also serves as a heat exchanger for the removal of the motor's electrical losses.

Conduction of heat from the pump to motor end is reduced by an air-cavity-type thermal barrier. Stator windings are protected from the heat in the magnetic gap by a double wire-mesh thermal barrier between the stator can and stator laminations.

Hydraulic Pipeline Dredge

A HYDRAULIC pipeline dredge, featuring the ability to work where other floating dredges cannot, has recently been developed by the Ellicott Machine Corporation, Baltimore, Md.

Designed for digging and maintaining narrow canals, channels, and irrigation ditches, or for any dredging job where maneuverability and small size are essential, the dredge comes in 6, 8, 10, and 12-in. sizes. The smallest model, whose reinforced stress-resistant steel hull is 28 ft long, 11 ft wide, and 3 ft deep, can work in close quarters only slightly wider than its own width, as can the dredges of the increased sizes. All of these machines dig their own flotation and low superstructure permits passing into areas formerly inaccessible to hydraulic dredges.

A feature of these canal "Dragon" dredges is their complete hydraulic control for all operations from a single control panel, necessitating the services of a one-man crew. The hydraulic circuit is made up of one dual hydraulic pump, five fluid motors, and nine hydraulic cylinders. A diesel engine supplies prime power to the dredging pump and for the hydraulic pump, which provides a system pressure of 2000 psi maximum. The machines have horsepowers varying in degrees from 60 to 200, depending on their size.

Characterized as a swinging-ladder-type dredge, the ladder assembly is attached in such a manner that, in addition to vertical movement, it also swings laterally. This new feature eliminates the great width needed for the entire dredge to swing in making the arc of a cut and permits the canal Dragon's hull to remain stationary. Positive control of the ladder movement insures an accurate cross section and smooth canal contour.

Another unusual design characteristic is the equipping of the dredge with four spuds instead of the usual two. With an arrangement of two forward-walking spuds on the bow, one at the stern and one at the starboard side to assist in moving around the curves, the dredges have greatly increased stability and maneuverability, raising appreciably their working value in confined areas.

A completely self-contained unit, the canal Dragon needs no auxiliary motive equipment or assistance from the land near the waterway where it is working. Engineered to give high power in a small hull, the 6-in. canal dredge can dig 30 to 60 cu yd per hr, depending on the type of material being moved. It can transport this material at the side of the channel or up to 200 ft away. The larger-size canal dredges have corresponding larger work capacities.

The dredge is equipped with a suspended discharge pipe, which allows material to be placed behind a berm at the side of the canal without additional pipeline. Elevated 13 ft above the water line, the reach of the pipe from the side of the dredge is 25 ft. The discharge pipe can also function as a rudder. By placing the intake pipe in the water, the pump can eject the water with sufficient force to move the machine and with the discharge pipe operating on a swivel, the dredge becomes self-propelled and guided.

Induction-Motor Factory

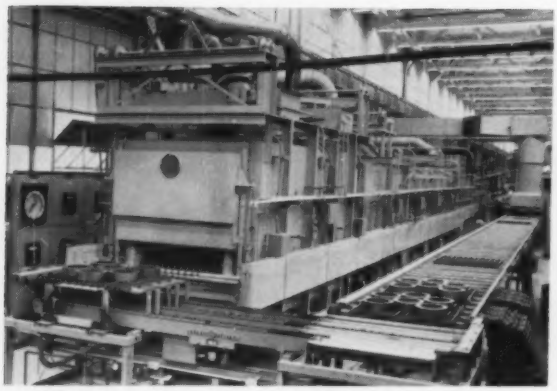
A NEW factory for manufacture of induction motors was unveiled recently in Schenectady, N. Y., by General Electric Company's Medium Induction Motor Department.

Built at a cost of approximately $7 million, the new facility was designed to meet the rapidly expanding motor market which is expected to increase at least 75 per cent, industrywide, by 1965.

Actually three plants under one roof, the new motor plant has made possible a three 8-hour-shift production cycle on standard models of the $7^1/_2$ to 30-hp motors in the Tri-Clad 55 line. Formerly it took two weeks to produce these motors.

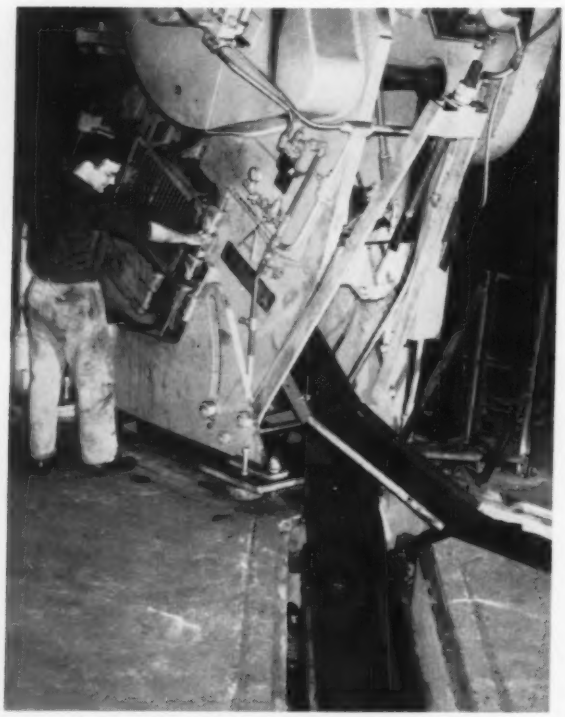
Standard models are manufactured in a straight-line flow on left and right assembly lines, with special motors produced in a middle line which draws standard components from the other two.

The new manufacturing processes have reduced to two



Hundreds of pounds of rotor and stator punchings are annealed here every hour with only one pass through this furnace

End shields are machined at multiple stations. New tooling and equipment helps assure better alignment of bearings for longer life.



This "blanking" punch press operates on a fully automatic cycle. Punchings produced from rolls of sheet steel are moved on for further punching via under-floor conveyers. Metal floor boards are removed to show operation.

the number of major hand operations involved. However, despite the reduction in hand operations, the new plant employs more personnel than ever before. This was attributed to the Department's ability to keep up with a rapidly expanding induction-motor market.

The principal hand operations still in use on the two standard lines involve stator winding and a portion of final motor assembly. All other operations are performed on machines which function automatically—most in a series of progressive machining.

Designed from a "building-block" approach, the factory produces more than 100 standard models, plus a wide variety of special motors.

Motor parts progress toward final assembly and testing along roller-type conveyers, with an overhead suspension system employed as needed for the handling of materials and for such operations as moving the wound stators through an automatic dip-and-bake processing.

A feature of the standard lines is an array of automatically operated punch presses stationed at the beginning of both production lines.

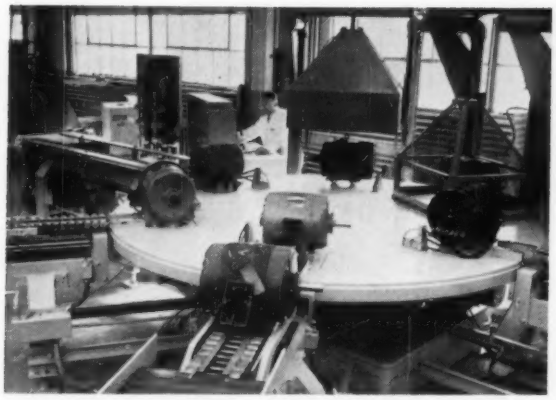
The punching operations are fully automatic—including feed of the sheet steel into the presses, movement of the punchings from blanking to indexing presses via magnetized conveyer belts, and removal of metal waste.

Metal scrap from the punchings is collected under the floor in an automatic operation conveying it to a chute which shakes the scrap into a large bucket. The cycle is concluded as the bucket fills to a preset load, when it automatically lifts to a position where the scrap is dumped into a collection truck outside the building. The bucket then returns again to its original position at the end of the chute. Shaking operation of the chute starts and stops at set intervals as part of the cycle.

All machining operations on 250-size frames are performed at a single machine where the feet are milled, footholes and conduit-box holes drilled, shaft hole bored and rough-finished, and holes bored and tapped for the end-shield bolts—all in a progressive series of automatically controlled operations. Each was previously a separate operation performed at four different machines.

In another fully automatic operation, wound stators are passed through three ovens in a dip-and-bake processing on a preset cycle of about six hours. They are progressively preheated, dipped into varnish, baked, given paint dip, baked again, and finally given silicone dip. Hand operations are limited to loading and unloading.

All motors are tested automatically on a circular platform at the end of each standard line. Designed to handle six motors at a time, the platform is rotated to perform tests on a total three-minute cycle for such fac-



All motors receive running, sound, and electrical characteristics tests automatically on rotating tables at end of each standard line

tors as vibration, noise, electrical resistance, high-voltage reaction.

A previous production-line test for turn-to-turn failure, unbalanced resistance, and high voltage is given at the point where the wound stators are prepared for the dip-and-bake processing. At regular intervals fully assembled motors are selected for additional testing. Along both standard lines and the special line all operators check their own work as it progresses toward final assembly. "Floating inspectors" also check the work at various stations.

As they leave the final test platform the motors are crated and raised by an automatic lift into a giant slotted storage bank.

Accommodating more than 1000 boxed motors at one time, the bank receives the motors at one end—placed into slots according to size and model—and by means of sloped roller conveyers allows each box to move forward as the boxes ahead are removed.

On the normal production schedule, each of the more than 100 standard models is manufactured every two weeks. However, the flexibility in the new layout permits change of the schedule at any time to meet a particular market demand.

450,000-Kw Steam Turbine-Generators

Two 450,000-kw coal-burning steam-electric generating units—the largest ever undertaken in the history of the electric-power industry—will be built on the American Gas and Electric System, it was announced by Philip Sporn, Hon. Mem. ASME, president of AGE. Each will cost an estimated $55,000,000.

Mr. Sporn said that the units will attain a higher level of efficiency in the production of electric power than has ever been achieved before. They will combine a great many outstanding features, including a large number of record-making specifications or performances, and are the result of several years' work in research and development carried out by the three organizations involved.

The turbine-generators for the units will be built by the General Electric Company and the boilers by The Babcock & Wilcox Company.

Each of the 450,000-kw units will be 73 per cent larger than any single power unit operating today anywhere in the world; capable of supplying all the residential electric requirements of a city with a population of 4,000,000; consume 1,300,000 tons of coal a year; and utilize 3,000,000 lb of steam per hr at the above-critical pressure of 3500 psi.

The units will be installed on the power systems of two of the three largest companies in the AGE System: Appalachian Electric Power Company, Ohio Power Company, and Indiana & Michigan Electric Company. Studies of site and fuel considerations, however, will not be finalized for several months, at which time the exact locations will be announced.

Each unit will consume over 150 tons of coal per hr for every one of the 8000 hr a year it is expected to operate. The fuel will be either pulverized or finely crushed.

Each boiler will be of outdoor design, as high as a 23-story building, and will exhaust to an individual poured-concrete stack approximately 500 ft above ground level.

The boiler operating pressure of 3500 psi will be well above the critical pressure of steam, 3206 psi. The boiler will be of the "once-through" type: Water entering at one end will absorb heat and in a single passage will come out as steam at a temperature of 1050 F.

The turbines will be of the cross-compound type, the high-pressure element operating at 3600 rpm and the low-pressure element at 1800 rpm.

The 3600-rpm generators will be liquid and hydrogen-cooled—the stationary part or stator (armature) being cooled by oil circulating through its hollow high-voltage windings and the rotor (field) being cooled by hydrogen.

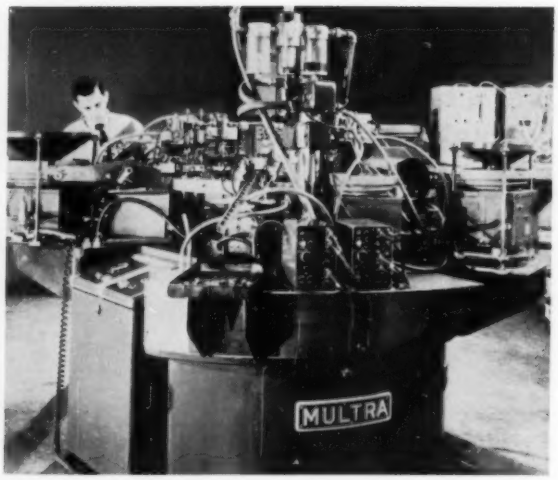
The steam cycle will use double reheat: Steam from the boiler, after its passage through a portion of the turbine, will return to the boiler to have its temperature, which has been lowered by its previous expansion, raised again; it will then return to the turbine where it will expand further and be returned to the boiler again to have its temperature raised once more. On its second return to the turbine it will complete its expansion and will then be condensed and returned as water to start the cycle of conversion to steam and generation of power over again. The two reheat temperatures, like the initial steam temperature, will be 1050 F. Double reheat, coupled with the units' size and their supercritical pressure, will give them an expected new standard for thermal efficiency in commercially installed generating units—close to 41 per cent. By comparison, the best record for a steam plant in 1955 was a thermal efficiency of 37.5 per cent established by Kyger Creek Plant of the Ohio Valley Electric Corporation.

Automatic Assembly Machine

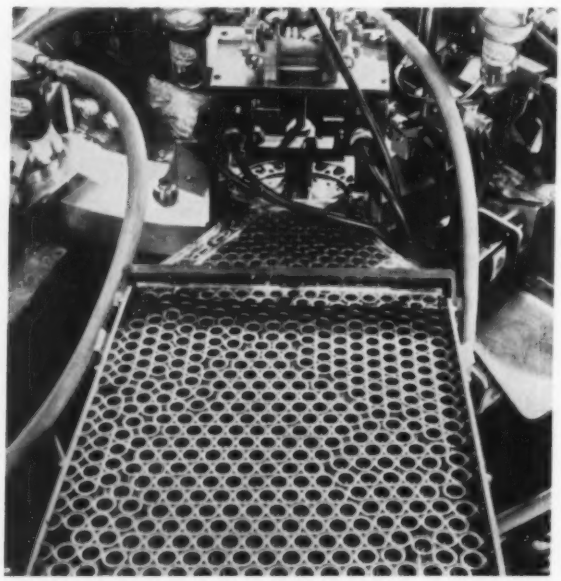
A MULTIPURPOSE automatic assembly machine called Multra is turning out between 15,000 and 20,000 mercury batteries per 8-hr shift on a regular production basis for P. R. Mallory & Company, Inc., North Tarrytown, N. Y., it was revealed recently. By changing tools—a simple matter of a few hours—other products may be assembled on the same machine.

Designed and built by the Multra Corporation, a subsidiary of Barnes Engineering Company, Stamford, Conn., the machine automatically performs all of the battery assembly operations that normally require a human operator. The machine feeds, sorts, sizes,

Basic Multra automatic assembly machine can be tooled up to assemble a wide variety of products



Complete automatic assembly machine set up for mercury battery assembly



A feeding station of the automatic assembly machine. The parts are automatically sized, oriented, and fed into the battery subassembly. Defective parts are rejected.

forms, orients, and inspects five different battery parts. These parts include such varied forms and materials as metal cylinders and caps, felt absorbent, neoprene grommets, pressed metal, and a liquid electrolyte that Multra also meters into the battery assembly. Mercury batteries are finding increasing usage in portable radios.

Multra also features a "feedback" system, a characteristic of all true automation systems: If a part should fail to be inserted at one of the stations, then the particular subassembly with the missing part is rejected at a later station but, meanwhile, no further parts are fed into it.

The complete machine weighs more than 7000 lb. It carries the battery subassembly from one work station to another where parts are inserted or work is performed. Parts are fed from work nests located around the machine at the work stations. The machine can be positioned, i. e., "indexed," with an accuracy of ±0.002-in. There is room around the 6-ft-diam table for 16 tooling stations, although not all stations are tooled for the battery assembly operation. Multra machines may also be built on a straight-line principle, depending on the particular job at hand.

Machine-Tool Outlook

Machine-tool shipments for 1955 (metal-cutting types only) totaled approximately $670,400,000 by comparison to $891,750,000 in 1954, and $1,191,200,000 in 1953, according to the National Machine Tool Builders Association.

In the fourth quarter of 1955 rate of production was substantially higher than that of the previous nine months. This partially reflected sales resulting from the Machine Tool Show held in Chicago in September, 1955, at which latest new models were exhibited, which stimulated programs of modernization and replacement.

Shipments during the first three months of 1956 have continued at substantially the same rate as the last three months of 1955. The upturn in operations, by comparison to the year previous, is shown in the following figures:

Shipments, first quarter 1955: $159,150,000
Shipments, first quarter 1956: $193,350,000

Current backlog for the industry is equivalent to approximately eight months' output. Backlog varies greatly, however, with individual companies.

Foreign orders continue to represent about 10 per cent of the total, and government buying for national defense has been averaging approximately 8 per cent. The main bulk of new orders represents a universal awareness, throughout industry in general, of the need for reducing costs and improving productivity.

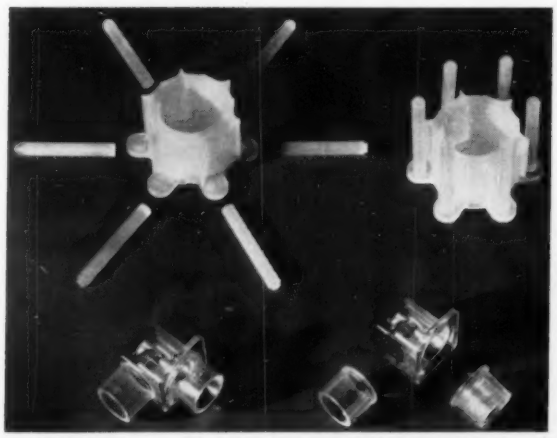
While the industry as a whole is still producing at a rate substantially below capacity, some companies are operating at full rate and subcontracting in addition.

It is probable that rate of operations of the industry as a whole will increase during the course of the year.

Investment-Cast Polystyrene Prototypes

ENGINEERS of the Bell Aircraft Corporation, Buffalo, N. Y., and Precision Metalsmiths Inc., Cleveland, Ohio, co-operated to develop polystyrene prototypes to be investment-cast. This new development tool is said to save valuable time, reduce costs, and speed up product development and changes.

It was found at Bell, that in the development stages, parts for guided missiles required frequent alterations in design and materials, while they are being proved for the Armed Services. Such changes can run up costs tremendously and considerable time may be lost if the parts have to be hogged out of solid metal or if dies have to be revised for every change in design. The use of polystyrene as development patterns for investment casting avoids much of this waste.



Parts as machined from polystyrene plastic for investment casting

The part is machined from polystyrene plastic exactly as it is to be investment-cast, allowing of course, for proper tolerances and shrinkage.

If the part is too complicated to be made as a single piece, it could be machined in sections and bonded together. These plastic parts are then used as expendable patterns and are investment-cast in the alloy desired.

Should the cast development part require changes in dimensions and material, or be altered in design, it is then only necessary to produce another polystyrene plastic prototype incorporating the desired changes and have it recast.

The following timetable for the first Bell Aircraft development job using the polystyrene-pattern method should be of interest to other engineering groups: On July 6, 1953, Bell Aircraft sent Precision Metalsmiths the drawing of a new part and asked that they redimension the drawing, allowing for proper shrinkage and gating. The drawing and suggestions were returned to Bell within two days, and on July 29, 10 Polystyrene test patterns were delivered to Precision Metalsmiths in Cleveland. Three days later the castings were back in Bell Aircraft's plant.

Not a cent was spent for dies during this development work and when the part was approved for production, it had already been proved right as to function and performance. Castability, of course, had also been established.

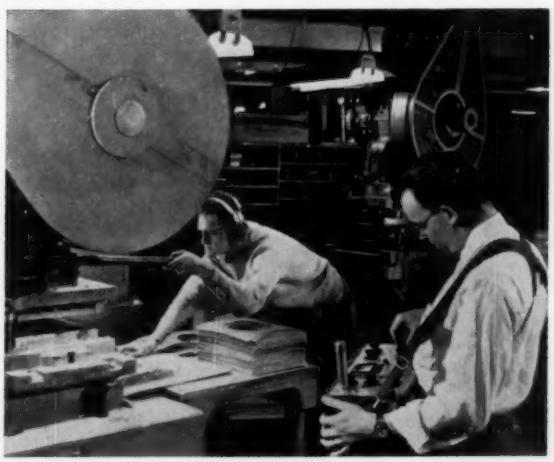
Noise Analyzer

AN INSTRUMENT that combines in a single portable unit four principal functions necessary to measure and analyze industrial noise accurately, was introduced recently by Mine Safety Appliances Company, Pittsburgh, Pa. Acoustical engineers, industrial hygienists, safety directors, industrial designers, audiologists, city planners, speech experts, and many others concerned with the problem can use the instrument to track down and measure hazardous noises.

Called the "Soundscope," the instrument serves as a meter to measure over-all sound levels. It also operates as an analyzer, measuring sound in each of eight octave bands to determine noise peaks. In addition, it can check sounds in narrower frequency bands. Electrical and acoustical calibrators are built into the unit.

The 20-lb instrument takes the place of four individual units previously required for noise analysis. It is expected to play an important part in efforts to control noise, which the American Standards Association reports has resulted in $2 billion worth of claims being filed against industry.

Because the instrument is portable, self-contained, simple to operate, and incorporates necessary analytical features, its widest use will be in the field of industrial noise prevention to combat occupational loss of hearing.



Tracking down potentially harmful industrial noises is the job of the Soundscope, developed by Mine Safety Appliances Company, Pittsburgh, Pa. The unit combines the functions of four instruments previously required to measure and analyze noise accurately. Here, a technician takes sound-pressure-level readings at a punch press. The press operator is wearing M-S-A Noisefoes, ear-muff-type protectors that guard against noises.

Each of the instrument's 14 tubes is mounted on a shock-absorbing pad and the first tube in each amplifier unit is encased in a metal shield. Subminiature vacuum tubes are used, along with printed circuits to reduce the size of the instrument as well as to prolong the service life of the seven dry-cell batteries that supply power.

When used as a sound-level meter, the Soundscope picks up noise through its microphone which literally transforms sound into electrical energy. The sound-pressure level is measured by passing the electrical signal through attenuators and amplifiers to the meter. The reading appears on the meter calibrated in decibels.

Measurement range is from 24 decibels, about that of a very quiet home, to 150 decibels which is considerably higher in sound pressure than an air-raid siren. The relative energy between these two extremes is far greater than the numerical difference in decibels indicates. A 60-decibel reading, for example, is equivalent to one million energy units while 120 decibels is comparable to one trillion—a million times greater. An increase of only three decibels in sound intensity more than doubles the vibrational energy of noise reaching the ear.

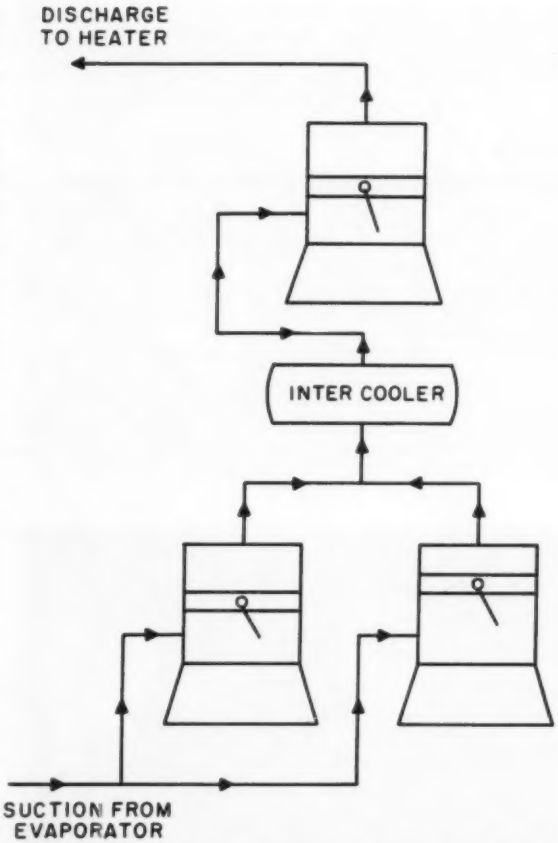
In the analyzer section of the instrument, noise is filtered into any of the eight principal octave bands, from 75 cycles to 19,200 cps. Noise peaks in each of these bands then can be measured individually. For finer analysis, by frequencies within the octave bands, continuously variable filters are used.

Importance of breaking sounds into frequencies to measure intensity levels is based on investigations which show that the ear is more susceptible to some frequencies than others. Thus technicians can accurately determine the offending frequencies.

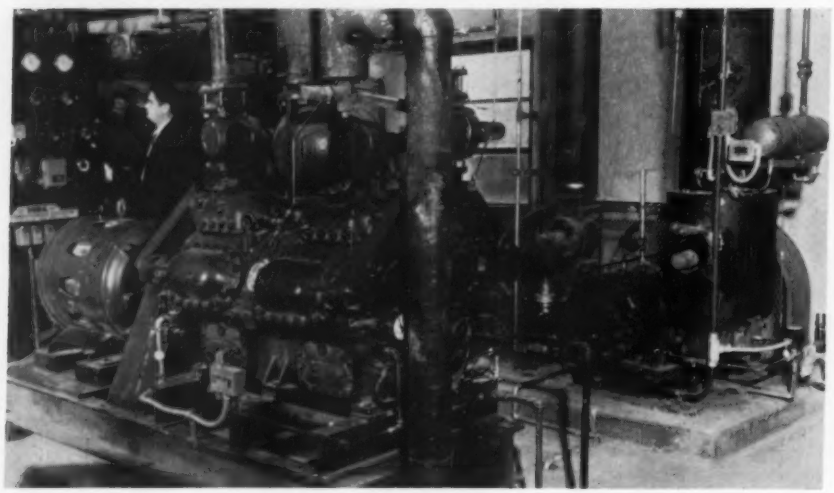
Air Heat Pump

A PRACTICAL system of heating a building without fuel by using below-freezing outside air as a heat source was announced recently by the York Corporation.

The company has applied for patents on a heat-pump system capable of heating a building using freezing or below-freezing winter air processed by the same refrigeration system used to cool the building during the hot



Compound, or multistage compression, shown schematically, is used in York's new heat-pump system to lower compression ratios and increase output during very cold weather, thus providing comfort heating of a building without the use of any supplementary heating. The new York compound-compression-pump system automatically switches from single-stage compression to compound compression when the outside temperature drops below a certain point.



Reciprocating compressor (*foreground*) for high-stage operation and rotary low-stage compressor (*right*) form one of the three York compound-compression heat-pump systems in the Heironimus Department Store in Roanoke, Va. Each system has its own gage board (*left*) which indicates refrigerant pressures.

summer months. No supplementary heating system is necessary.

York's new development does away with the need for readily available well or sea water or any supplementary heating by making use of a long-known refrigeration technique—compound compression—which has been used for years to achieve economically the extremely low temperatures used in ice-cream plants and the frozen-food industry.

As developed by York, the heat-pump system automatically heats or cools the rooms in a building, depending on the climatic conditions, and always provides the desired room temperature. Thermostatically controlled valves guide the hot or cold-water flow in and out of the system while the compressors automatically move from single-stage compression into compound compression when the temperature drops below a certain point.

Using only the electricity needed to run the compressors, which form an integral part of the basic refrigeration unit, the York heat pump can remove heat from zero degree outside air while cooling this air to still lower temperatures as it passes over specially designed coils. The heat removed by the refrigerant from the outside air is elevated to a usable temperature level by the compression cycle. This heat can be used to produce hot water, which can be circulated throughout the building in an indirect system, or the hot refrigerant can be used directly in coils to provide forced warm-air heating through either a central unit or multiple units.

During warm weather, conversely, the expansion, or cooling of the refrigerant as it turns from liquid to gas, extracts heat from the water circulated through the refrigerant. The resulting chilled water is piped to the same coils and cools air blown through these coils.

Two new buildings are presently using, or being equipped, with the new York heat-pump system. The Heironimus Department Store, in Roanoke, Va., was completed recently. The Ballinger Building in Philadelphia, Pa., will be completed this month.

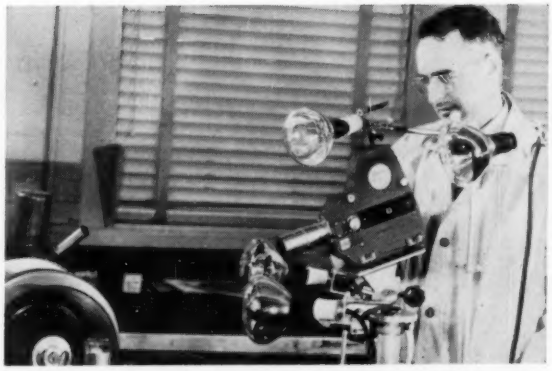
Although York is supplying the new heat pump to industrial and commercial buildings at the present time, the company's research and engineering departments are currently working on the miniaturization of the system into packaged units to make home use of the heat pump practical at some future date. If this work progresses satisfactorily, indications are that a practical and economically feasible heat-pump system could be ready for home heating and cooling sometime during 1957.

Motion-Analysis Camera

A HIGH-SPEED, lightweight, compact "motion-analysis" camera, capable of taking high-quality pictures within range of 5000 per sec and incorporating the most advanced features of high-speed photography, has been designed by the Fairchild Camera and Instrument Corporation of Syosset, N. Y.

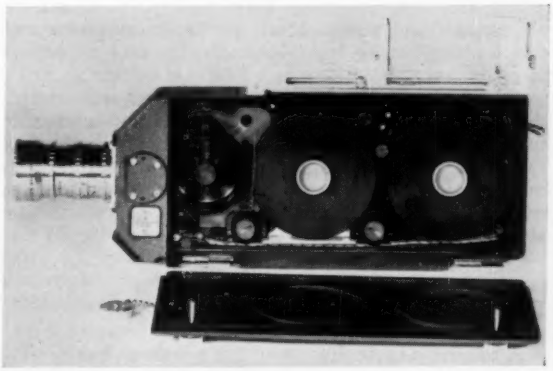
Utilizing rotating prisms, this 16mm camera can be adapted to many variations, each for a specific use. An industrial model is planned which is capable of taking as many as 5000 pictures per sec; an air-borne model has been designed which has a maximum picture-taking rate of 2000 per sec; and a missile hit-miss model, already proved to take 250 pictures per sec, is being engineered to take as many as 1000 pictures per sec. Both the industrial and air-borne models have film capacities of 100 and 200 ft, using daylight loading spools.

The resolution tests of the MAC are said to be equal to, or better than, those obtained with intermittent cameras, operating the intermittent cameras at 64 pictures per sec



Typical indoor application of Fairchild's new high-speed motion-analysis camera is both easy and simple to set up. Here an "electronic tone wheel" is tested for chatter.

At the site of a high-speed sled track, John H. Waddell, designer of the new Fairchild motion-analysis camera, prepares to "slow down" a rocket sled with 2000 pictures per sec



The new high-speed motion-analysis camera features this simplified design for air-borne use. It has a 100-ft film capacity.

and more. Picture steadiness on projection is much better than that of the intermittent cameras. By means of precision gearing associated with the prism drive mechanism, the more steady picture is achieved.

The rotating prism has been selected for the highest possible index of refraction and lowest dispersion with a minimum thickness and minimum angle of incidence. The result is an evenly illuminated picture that has a sharp frame line, with no overlapping of images of one frame into the next.

Since the introduction of high-speed color film, glasses of higher indexes of refraction could not be used because they have color, generally yellow. Therefore a rare-element glass was selected for the 4-sided prism which was as nearly "water-white" as possible and still had a high index of refraction and a low dispersion. Thus the image produced is free from "color fringing" and color photography is possible without the use of color correction filters.

The rotating prism shaft of the MAC is so mounted that the camera will operate at 55*g* shock without causing optical distortion or malfunction. Picture tests of live subjects indicate improvement in sharpness and contrast, as well as steadiness, which means that it is possible to make single frame enlargements from the original film.

To give particular speed ranges, a family of interchangeable 28-volt d-c motors are used to drive the several MAC models. Because of their lightweight and small size, the motors can furnish maximum acceleration in a minimum time and the camera has sufficient power to start at high speed.

One of the most advantageous features of the camera is its ruggedness. A minimum of maintenance is required. The housings are heat-treated cast-aluminum alloy and so designed to take high *g* shock. It is built to operate at 55*g* constant acceleration, 10*g* vibration at or through a range of 10–500 cps, at temperatures from —65 F to 200 F, 100 *g* shock.

The MAC is relatively inexpensive yet produces steadier pictures at ranges from 100 to 1000 pictures per sec than those obtained with intermittent cameras.

It is simple to operate. There is only one switch on the camera, and two sockets; one for motor power and one for the timing light. Loading is said to be extremely simple.

The camera is capable of being stopped and started. At picture-taking rates up to 100 per sec, an adjustable brake can be set to prevent overrun of the feed spool when the camera is stopped and started for several runs on a single roll of film. In addition, the speed of the camera can be varied during the passage of the film through the camera.

Drawing Table

A DRAWING table that should be a boon to engineering colleges and universities has been designed by Ronald B. Furry, an instructor at Cornell University, Ithaca, N. Y.

Mr. Furry's new 3×5-ft table has four unit board racks with space for a drawing board, T-square, and paper supplies on the left side, and four drawers on the right.

This is novel. Most drawing tables used by draftsmen have much less storage space, usually only one small side drawer and a long middle one. Increased storage space per table permits better use of classrooms and more students can be accommodated.

Ronald B. Furry, instructor in Cornell University's department of agricultural engineering, shows storage space in the new drawing table he designed for college use

Forty-one tables designed by Mr. Furry are now being used by the University's department of agricultural engineering. Mr. Furry uses them for teaching courses in mechanical drawing and descriptive geometry.

Some of the tables are equipped with drafting machines which are used by advanced students. The tables are being made by the Hamilton Manufacturing Company of Two Rivers, Wis.

Titanium-Metal Production

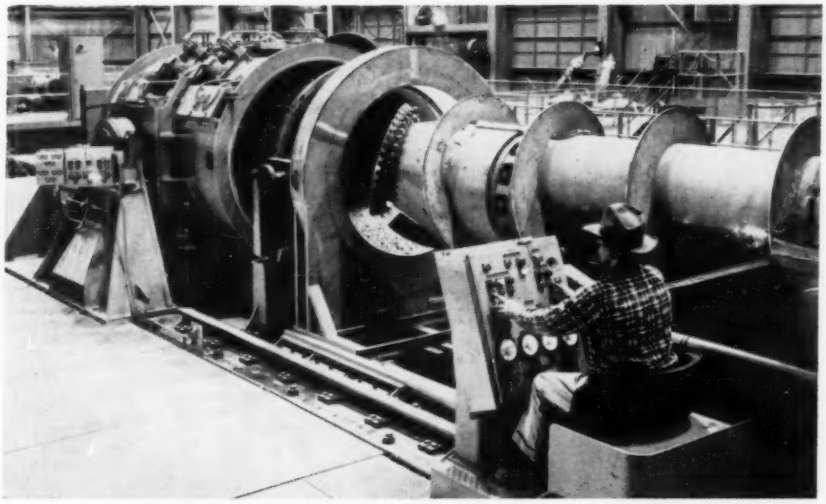
THE first heat of titanium metal sponge at the new Ashtabula, Ohio, plant of Electro Metallurgical Company, a Division of Union Carbide and Carbon Corporation, was completed recently. This heat produced by the sodium-reduction process marks the entry of Electromet into the titanium-metal-sponge field on a commercial scale.

The plant, which has a capacity of about 7500 tons of titanium-metal sponge a year, is the largest built to date and was privately financed by the company. The new plant is located on the Lake Erie site of Electromet's plant for the production of ferro-alloys and calcium carbide at Ashtabula.

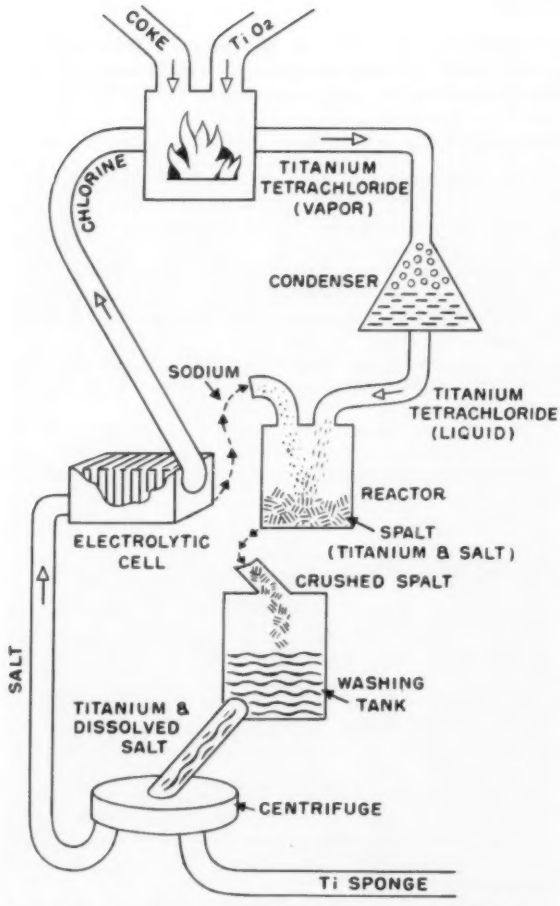
New Process Used

This is the first commercial production of titanium sponge in the United States by a method other than the magnesium-reduction process. In Electromet's process sodium is used to reduce titanium tetrachloride, resulting in metal of high quality. Economic and technological considerations led to the commercial development of the sodium-reduction process, after extensive studies of other reduction methods. The company has had this process in operation on a pilot and prototype plant scale at its Metals Research and Development Laboratories in Niagara Falls, N. Y. The titanium sponge produced by Electromet is remelted into ingots by producers of titanium mill products and commercial shapes.

While titanium is only 60 per cent heavier than aluminum, its engineering alloys are more than twice as strong as the best commercial aluminum alloy. Although titanium is only about half as heavy as steel, its



Removing the titanium product from the reactor at the Ashtabula, Ohio, titanium plant of Electro Metallurgical Company. Electromet's final product is sponge titanium, or crystals, which are remelted into ingots by producers of titanium mill products, and then rolled into commercial shapes.



Sketch showing transformation of titanium ore (TiO_2) into titanium sponge by the sodium-reduction process at Electromet's new titanium plant at Ashtabula, Ohio, the first large-scale plant to use this process

alloys for engineering use approach the tensile strength of most alloy steels.

Titanium alloys maintain their strength at temperatures up to 700 F, where other lightweight metals lose strength rapidly after about 300 F.

Titanium has excellent resistance to corrosion by air, salt water, nitric acid, wet chlorine, and organic and inorganic chloride solutions.

How Titanium Is Used

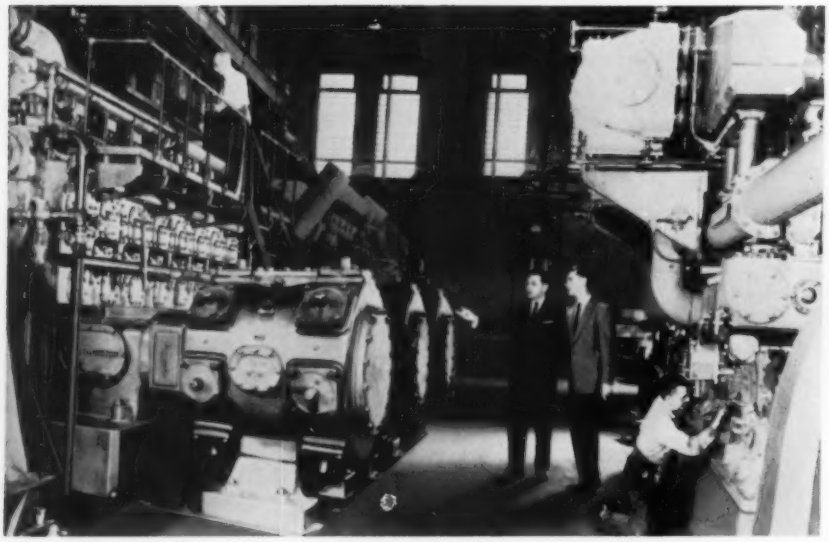
Uses of titanium metal, at present, are restricted largely to military applications, principally in aircraft. Because of its unusual properties, however, civilian uses taking advantage of these properties are expected to develop as the metal becomes more plentiful. Because it has the strength of steel, yet is so much lighter, the metal is specially suited for aircraft components such as airframes and nacelles. The high strength and corrosion resistance of titanium make it particularly useful in equipment where there are moving parts subject to corrosive service such as in jet engines. Potential uses include reciprocating parts of many other types of machinery. Many important civilian and industrial uses offer sizable potential markets. Among the biggest will be chemicals, petroleum, food, marine, electronics, and atomic energy.

Titanium sponge has had a spectacular growth from a mere three tons in 1948 to 7200 tons in 1955, and an estimated 13,000 tons this year. The Electromet plant is expected to reach rated capacity of 7500 tons per year by the fourth quarter of 1956.

Gas-Engine Compressor

A NEW gas-engine compressor known as the SUTC Turbo-Uniflo has been designed and developed by Worthington Corporation. The engine-compressor, available in 750 to 2500-hp range, is the only two-cycle spark-ignition gas-engine compressor that operates with a completely independent exhaust gas-driven turbocharger.

Operating at relatively high compression ratio, the Turbo-Uniflo has smooth combustion characteristics.



The Turbo-Uniflo—Worthington's SUTC gas-engine compressor. *Right:* Engine reveals side of SUTC with the turbocharger. *Left:* Engine view shows the compressor side of the SUTC with cylinders.

This is due to the basic timing arrangement, engine configuration, and design of the exhaust manifolding. The new design results in quieter operation, low fuel and lube-oil consumption, and low bmep—96.1 psi at rated speed and load. A complete absence of residual gases in the combustion chamber results in high turbocharging-scavenge ratio.

The SUTC Turbo-Uniflo is designed for pipeline transmission service; in natural-gasoline plants; for pressure maintenance in oil fields to maintain all increase in flows; for oil-refinery operations such as vapor recovery, recycling, and stabilization of gases; for refrigeration systems that are required in many chemical and petroleum field processes; and in the petrochemical industry where various processes require the use of natural gas under pressure.

The SUTC is applicable for any type of gas compression where suitable gas fuel is available.

Turbo-Uniflo Operator

Uniflow design makes self-sustained turbocharging possible from start-up through full load. Exhaust valves are timed to open and generate a pressure pulse to move the turbine blades. This gives self-sustained starting and quick acceleration without external aid or mechanical drive. A turbocompressor delivers air under pressure to the aftercooler. Cooled air enters the cylinders through inlet ports 360 deg around the liner. During the scavenging period, the combustion chamber walls and valves are effectively cooled.

The elimination of possible displacement scavenge pumps, probably the largest single source of two-cycle engine noises, permits quieter operation.

Insulated cast-iron exhaust manifolding, and a large scavenging-air plenum chamber are incorporated in the one-piece, cast-iron engine frame. Extra-large divided sections contribute to low air velocities and uniform air flow. Air pulsation usually found with pump-scavenged arrangements are eliminated by this construction.

Extra-heavy, triple-strand silent chain camshaft and governor drive eliminates noises familiar to gear trains. Hydraulic valve lifters on the cam-actuated exhaust valves assure continuous contact in the valve train, and the hydraulic valve cushion eliminates tappet noises.

Higher Efficiency

The SUTC engine gives very high thermal efficiences. Exhaust-gas energy normally wasted on two-cycle engines with mechanically driven scavengers is recovered by the completely independent exhaust gas-powered turbocharger. This supplies varying amounts of scavenging air, exactly matching air-gas fuel-ratio proportions throughout the entire range of speeds and loads required.

Because power is no longer required for a positive displacement scavenging-air source, more power is put to work in the engine compressor cylinders.

The normal parasitic loop-scavenge pump load is eliminated, increasing the over-all engine efficiency and giving a higher percentage of useful energy for compressor service.

Portable Earth Augers

Two portable earth augers which are designed to dig holes to considerable depths at rapid rates are undergoing tests at the Corps of Engineers' Research and Development Laboratories, Fort Belvoir, Va.

Developed by the H. B. Williams Manufacturing Company of Dallas, Texas, they are being considered for use in the construction of field fortifications and emplacements, shallow wells, and waste-disposal pits. Other possible applications are also under study.

The larger of the units weighs approximately 50,000 lb. Powered by a 192-hp gasoline engine, it is capable of digging holes up to 9 ft in diam and 75 ft deep in many types of earth strata.

Mounted on a standard military 25-ton low-bed trailer, the unit is 89 ft long in its traveling position. It features a turntable which permits digging and discharging of spoil on either side of the trailer.

A $5^1/_4$-in-sq kelly bar with a 2-in. hole in the center makes possible the use of air, water, and Calyx drilling attachments. Augers, auger buckets for wet material, and core barrels for drilling in rock are standard attachments.

Digging operations have been successfully conducted in sandy loam, calèchie, and decomposed granite. In sandy loam, the unit dug a huge hole on an average of $^1/_2$ fpm.

A smaller 34-ft, 24,448-lb unit, which utilizes smaller versions of the same components, can dig holes up to 6 ft in diam and 22 ft deep. Truck-mounted, it is highly mobile.

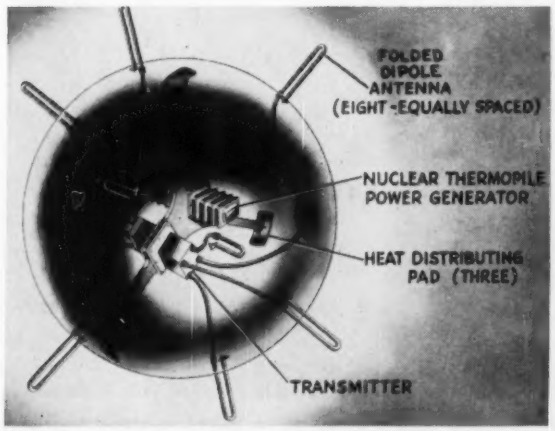
Man-Made Earth Satellites

MAN-MADE ASTRO satellites circling the earth every 105 min to serve as all-weather "space-compasses" for ships and planes were forecast recently by Lovell Lawrence, Jr., Mem. ASME, assistant chief engineer—product design, Chrysler Corporation Missile Operations, Detroit, Mich., before a Franklin Institute symposium on "Earth Satellites as Research Vehicles" in Philadelphia, Pa.

"The ASTRO (Artificial Satellite Time and Radio Orbit)," Mr. Lawrence said, "could be fired into outer space from Alaska on a course which would take it over the North Pole. A strong radio beam could be transmitted upward from the Pole to cut the ASTRO's power as soon as it comes over, letting it fall into its orbit 600 miles from the earth. Once in the orbit, it would travel at a speed of 276 miles per minute."

As explained by Mr. Lawrence, there would be three ASTROs fired into outer space eight hours apart to provide a radio signal that could be plotted from any point of the earth in any weather every 105 min.

An almanac listing the ASTRO space course, just as a farmer's almanac lists the position of the sun for every minute of the day, could be established by plotting the course of the ASTROs in their first revolution around the earth.



Power for the ASTRO satellite would come from the nuclear thermopile in the accordion-shaped generator shown in the drawing above. The eight antennas around the circumference of the ASTRO would enable it to transmit a navigational signal regardless of its position in space 600 miles above the earth's surface.

This ASTRO almanac would be the key to the navigation system. By fixing the exact minute when the ASTRO signal is the strongest, the ship or airplane navigator could obtain the position of the ASTRO at that particular minute from the almanac. He would then determine his position by computing the observed Doppler frequency deviation shift versus position distance from the ASTRO.

Power source for the ASTRO would be one pound of Strontium 90 combined with an Yterrium isotope which, Mr. Lawrence said, would provide enough power for 20 years, after which a new ASTRO would be fired into the orbit. The powerless or worn-out ASTROs would remain suspended in the orbit, in effect becoming "celestial trash."

Mr. Lawrence described the ASTRO as a sphere about 2 ft in diam with eight equally spaced antennas—shaped like croquet wickets and about 8 in. long—to transmit the signal.

"By use of the eight antennas we would not have to use any gyros to stabilize the position of the ASTRO. No matter how it spun, a signal would be transmitted to the earth's surface which could be picked up by the navigator.

"For the purpose of this discussion, I have made every effort to conceive a simple, yet reliable system that may be feasible in the near future. To accomplish this, however, a very high degree of accuracy must be maintained in the electronic components," Mr. Lawrence said.

What Price the Professional Engineer?

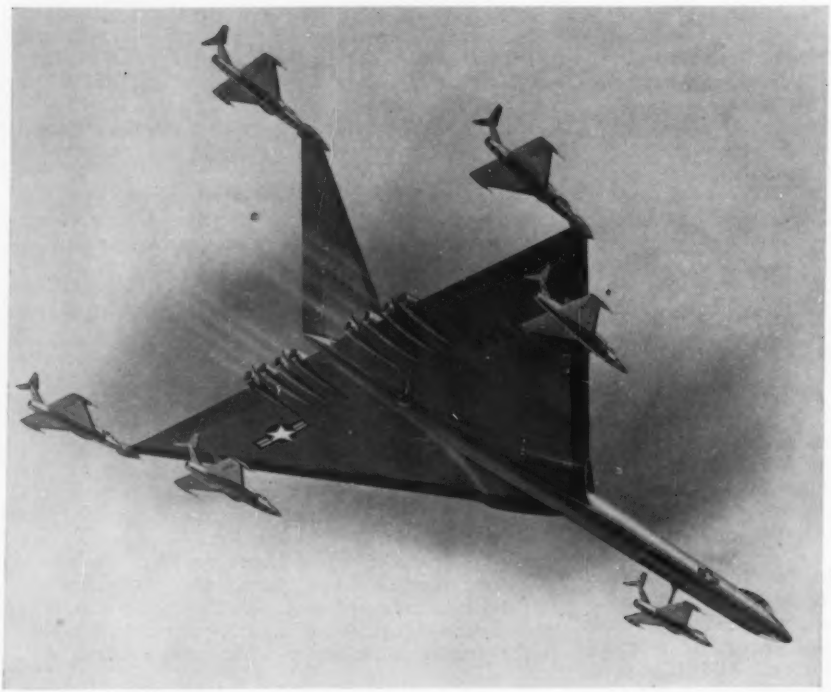
(Continued from page 516)

inspections, and other supplementary services as may be required, shall be made additional to the foregoing on the basis of not less than $75 per diem for the time of employed office personnel, and $150 per diem for time of the principals hereof, plus travel and/or other expenses incurred. (This figure of per diem cost can be varied in accordance with the stature of the engineers employed.)

To Prevent Cut-Rate Bidding

The rates here proposed are minimum recommended, meaning that some would be subject to increase as conditions might require, the object hereof being to establish minimum figures as a means of preventing unfair or ill-advised cut-rate bidding for professional-engineering services, with upward revisions based upon the competency of the professional engineer involved.

Under this plan of operation, which is totally in keeping with that practiced by the architects, the percentage of profit on small jobs in some cases might be insufficient. However, the source of present troubles with the profession is not with the small jobs. Moreover, since principal income and profits are derived from the larger projects and, further, that small jobs are usually for accommodation purposes, this feature should not be of effect. It is the over-all results that should be considered.



Atomic-Powered Bomber. A military concept of an atomic-powered bomber capable of carrying along its own fighter escort is pictured in this artist's conception. Called "Project Opossum," because of the resemblance to the manner in which opossums carry their young, the airplane was described at a recent meeting of the Society of Automotive Engineers in New York, N. Y., by Lee A. Ohlinger, atomic specialist and head of the Northrop Aircraft, Inc., computer center. The bomber would carry its fighters at high subsonic speeds unless alerted by its own radar of imminent enemy attack. It would then "shift into high" cutting loose its escort. The supersonic fighters would then set up a fighter screen to take the mother ship through heavily defended areas.

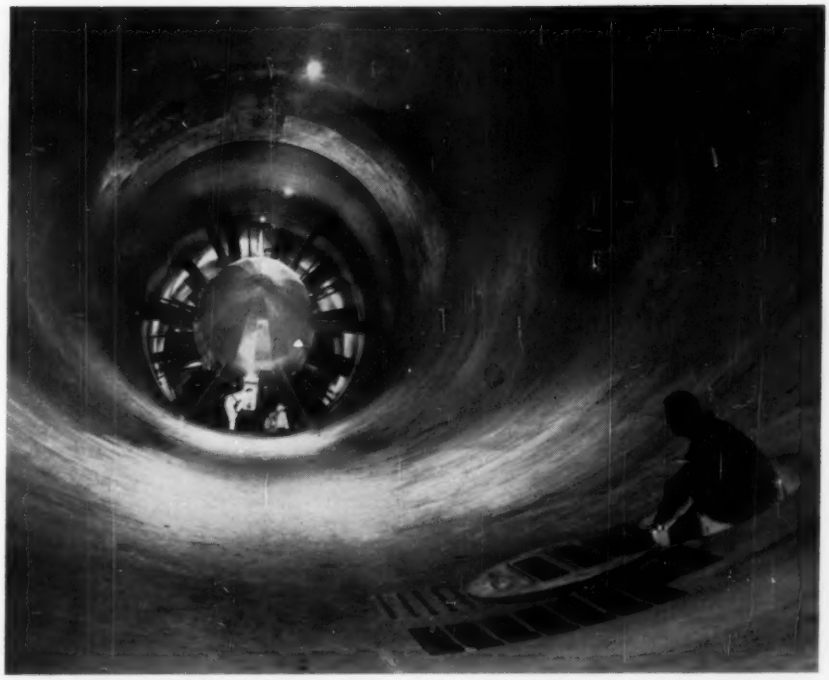
Aviation Developments . . .

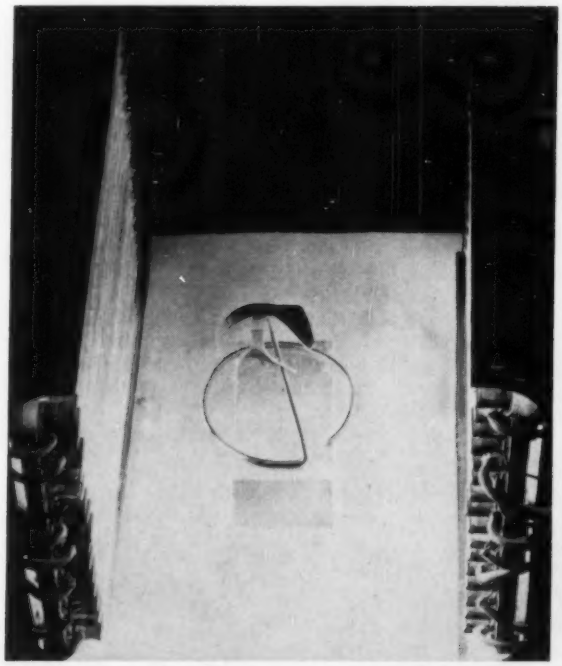
. . . at a glance

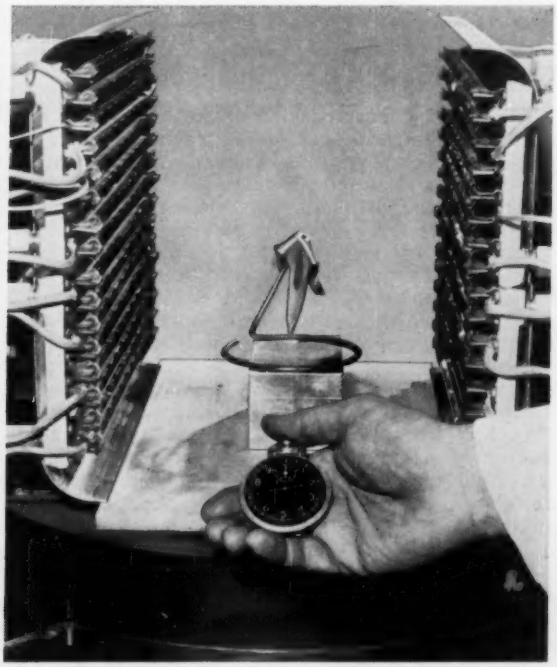
B-57E Twin-Jet Plane. Take-off during first flight of the U. S. Air Force's new B-57E twin-jet aircraft. The B-57E was built by Martin of Baltimore, Md., and is especially equipped to trail an aerial target at the end of a long cable, thereby providing a high-speed air-borne object for improving the shooting accuracy of our fighter aircraft and ground batteries. A feature of the B-57E is its convertibility, in an emergency, from a high-speed target-towing airplane to a tactical bomber.

Metals and Alloys Testing. A graphic illustration of the effect of ultrahigh temperatures caused by the friction of an airplane moving through the air at high speeds is shown in a primary stage, *left*, by Northrop Aircraft, Inc., engineers who are searching for new metals and alloys capable of withstanding the heat of the "thermal barrier." The small cutout air-

Wind Tunnel. Gales almost twice the speed of sound are started by these giant fans turning at 600 rpm at the Southern California Cooperative Wind Tunnel in Pasadena, Calif. The fan nacelle in the *center* above, houses the mechanisms that adjust the pitch of the fans. The manhole at *right* is an access hole into the wind tunnel. The Southern California Cooperative Wind Tunnel has been modernized at a cost of $8,000,000 to the supersonic capabilities of Mach 1.8. By the installation of two massive 20,000-hp electric motors, air velocities of the wind tunnel have been boosted to a maximum 1400 mph of sound. The expanded facility was dedicated recently in Pasadena.







plane is flanked by infrared quartz lamps capable of generating temperatures as high as 2000 F. The airplane facsimile is made of standard aircraft "skin" material—0.051 aluminum alloy. It is known to lose 10 per cent of its strength at 250 F. Ninety per cent of strength is lost at the friction heat generated at 2000 mph. Four seconds after a switch is thrown in the thermal test laboratory, *center*, the small cutout airplane begins to "wilt." Stainless steel used in some applications can withstand temperatures up to 3000 F. The small model plane, *right*, hangs limp on its supporting frame just $2\frac{1}{2}$ sec after current was turned on in the thermal furnace used for these tests at Northrop.

European Survey

Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*

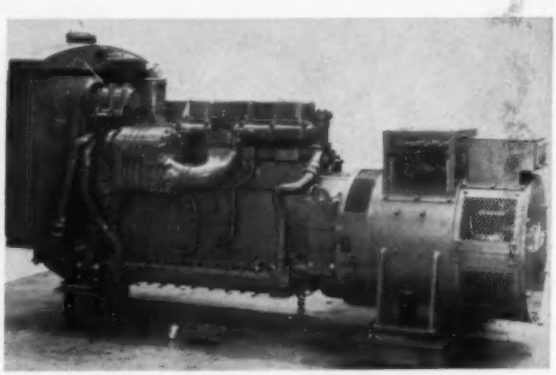
Double-ended Janus diesel-electric locomotive for steelworks

Diesel Locomotive for Steelworks

THE Appleby-Frodingham Steel Company's works at Scunthorpe, England—one of the plants controlled by the United Steel Companies, Limited—contains within its boundaries about 110 miles of railway track on which traffic amounting to some 300,000 tons a week has been handled hitherto by a fleet of 48 standard-gage steam locomotives. Several years ago the management decided to replace these with diesel locomotives, but were unable at that time to obtain one capable of doing the same work, which includes moving heavy ore and ingot trains and tipping slag ladles as well as the more ordinary haulage duties. They therefore prepared their own draft requirements, which the Yorkshire Engine Company of Sheffield—another constituent firm of the United Steel group—have now embodied in a new locomotive. It has been given the type name of "Janus," in classical allusion to the Roman deity after whom the month of January is named and who is represented with two faces, looking in opposite directions.

The locomotive is double-ended and may be driven with equal ease in either direction. There are two identical power units, which may be used either singly or together. Each consists of a Rolls-Royce C6-SFL supercharged oil engine directly coupled to a British Thomson-Houston Company's traction generator with a continuous rating of 124 kw at 1800 rpm. The traction motors, also constructed by the British Thomson-Houston Company, are spigot-mounted on axle-hung gearboxes and have a maximum speed of 400 rpm. The gear ratio is 22.85:1. The Rolls-Royce engines are four-stroke direct-injection units, with six cylinders $5^1/_8$-in. bore and 6-in. stroke, and a compression ratio of 14:1. They develop 200 hp at 1800 rpm, so that the locomotive has a total hp of 400. The starting tractive effort is about 30,000 lb and the tractive effort at continuous rating, 13,100 lb, at a speed of 8 mph. The maximum speed is 23 mph. The over-all length is 29 ft and the weight is 48 tons. The wheels are 3 ft 8 in. in diam and, with a wheelbase of 11 ft, the Janus can negotiate a curve of only 120 ft radius.

The design is such that it can be adapted to run on 5 ft 3 in. or 5 ft 6 in. gage, as well as the usual 4 ft $8^1/_2$ in. The fuel tank is built into the frame and holds 400 Imperial gallons, enough for about a week's normal



One of two 200-hp diesels installed in the Janus locomotive

[1] Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

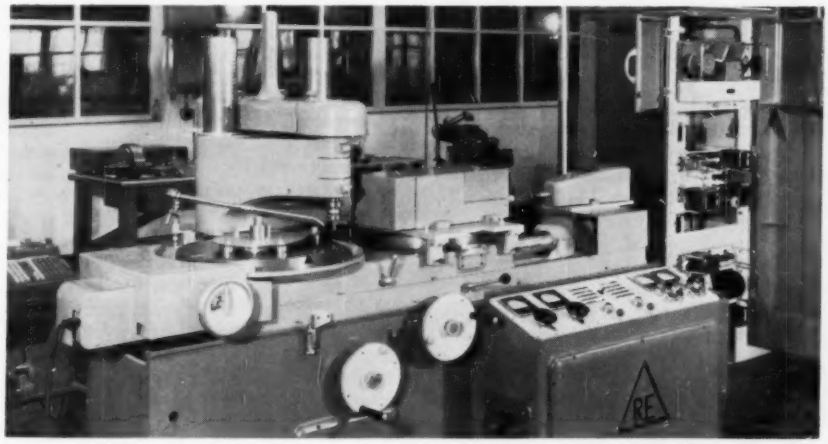
running. The driver's cab provides exceptionally good vision and is so arranged that there is a choice of four driving positions. In a recent demonstration the Janus took a 400-ton ore train up a bank of 1 in 170 with ease at twice the speed of a steam locomotive.

Automation in Practice

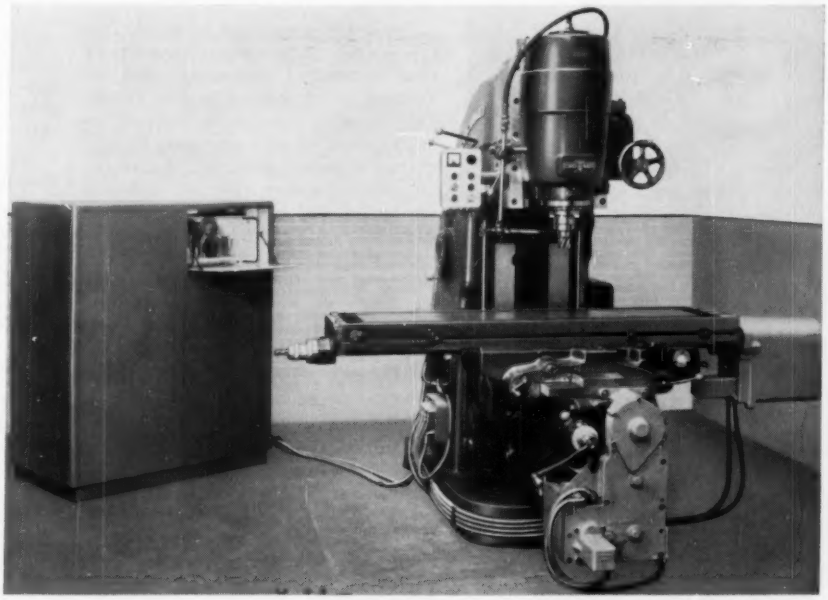
Electric & Musical Industries, Ltd., of Hayes, England (who are almost better known by their initials, "E.M.I.") have ramifications in these days far outside the production of gramaphones, on which the business was founded; gunfire-control computers, radar and navigation equipment, and various other applications of electronics have been among their activities for a number of years and it is not surprising, therefore, that they should be interested also in the electronic control of machine tools. They claim to have installed in a customer's factory the first example of an electronic analog machine-tool control in the world to be supplied to an independent user for ordinary routine production. It is applied to a machine which is used to produce high-precision cams. Another machine produces these plate cams by copy-milling from a handmade master, but the new modified machine produces them automatically, from information fed to it on a perforated tape. More recently, the same system has been applied to the control of a Cincinnati No. 3 vertical milling machine.

The complete installation consists of the writer, for preparing the tape, the control unit, and the machine tool. In the earlier machine the tape was of celluloid and was perforated with a special punch, but this procedure has now been simplified by the adoption of paper tape, perforated in a standard Creed teleprinter. Simultaneously, a typewritten copy is produced for checking.

The milling machine is modified by attaching servomotors to the longitudinal and transverse feeds. For the purpose it was found that sufficient accuracy could be obtained by taking measurements from the normal lead screws, so position-measuring devices were attached to them; this means that the accuracy obtainable depends on that of the machine, which is an ordinary production model, but it would be equally practicable to work from an independent measuring device, where greater accuracy was required. The control system provides information accurate to finer than 0.001 in. on dimensions up to 100 in. An agreement has been concluded recently between Electric & Musical Industries Limited and the Cincinnati Milling Machine Company for the joint study and development of electronic controls to machine tools.



Close-up of electronically controlled miller, with the doors of the control unit (*right*) opened. The top compartment of the latter houses the tape-reader unit, while below and behind are the information stores, interpolator, and servoamplifiers. On the *extreme left* is the encoder operated by a typist, which produces simultaneously the perforated strip and a typed record.



Longitudinal and transverse feeds of this vertical milling machine are servocontrolled and the lead screws are equipped with position-identifying mechanisms

ASME Technical Digest

Substance in Brief of Papers Presented at ASME Meetings

Aviation

Ventilated Clothing as a Protection Against Heat Exposure, by P. Webb, Wright Patterson Air Force Base, Ohio. 1956 ASME Aviation Conference paper No. **56—AV-4**(multilithographed; available to Jan. 1, 1957).

When exposure to heat in aircraft threatens to become excessive, ventilated clothing is the logical way to increase human thermal tolerance. Ventilation acts by improving normal heat loss from the body, principally through removal of water by evaporation, with subsequent cooling.

A brief description of the Air Force ventilating garment is given. Experimental testing of this means of protection against heat exposure is under way. The many variables which are important in the evaluation are presented and discussed. Some of these are environmental temperature; temperature of the ventilating air, which is more effective if cold; delivery rate of ventilating air, which strongly influences the amount of protection; barometric pressure which, when reduced, results in an improved tolerance to heat, even though the mass flow of air is reduced; and the type of clothing worn, which has a complex influence on the protection in a given situation.

In general, ventilation works quite well, and the amounts of cooled air needed to protect the man are much less than would be needed to cool the entire cockpit.

Air Force ventilating garment MA-2, to be standardized in the near future

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Development and Evaluation of an Icing Indicator, by M. P. Moyle, Assoc. Mem. ASME, and S. W. Churchill, University of Michigan, Ann Arbor, Mich., and Dr. Myron Tribus, Mem. ASME, and H. E. Stubbs, University of California, Los Angeles, Calif. 1956 ASME Aviation Conference paper No. **56—AV-1** (multilithographed; available to Jan. 1, 1957).

The development of an icing indicator is described. The indicator consists of two thermally conducting elements mounted in a nonconducting airfoil. The forward element is exposed to impingement of air-borne particles, and the rear element is sheltered. A theoretical analysis shows that an indicator can be designed which is insensitive to frictional heating and to changes in airspeed and ambient temperature. Water clouds above the freezing point and ice clouds do not produce a response which can be mistaken for icing conditions. Performance tests confirmed the theoretical analysis.

Human Problems in the Development of the F-102 Cockpit, by W. H. Reineking, General Dynamics Corporation, San Diego, Calif. 1956 ASME Aviation Conference paper No. **56—AV-2** (multilithographed; available to Jan. 1, 1957).

The human problems discussed in this paper are characteristic of most high-performance aircraft so that actually they relate to any high-performance interceptor. Basically, elements of design must provide for the survival of the pilot, prevention of injury, effective operation, and comfort.

Some of the ground rules for cockpit design, according to the paper, consist of the following:

1 Locate pilot for best visibility and maximum space for controls without unduly penalizing the performance of the aircraft.

2 Reduce the pilot work load wherever possible, especially at landing and take-off.

3 Improve the pilot's perception of his own situation.

4 The cockpit arrangement must be such that it will be operable with the pressure suit inflated to the maximum possible pressure for the peak altitude of the aircraft.

5 Arrange the controls for minimum time actuation.

6 Arrange the escape controls in close proximity to the regular flight controls for minimum escape time and optimum body position.

7 In producing a new cockpit for an existing model, care must be taken to reduce the hazard of habit interference.

8 Arrange controls for logical use.

9 Arrange the controls so that the proper hands can be used to actuate them.

Descriptions and Prediction of Human Response to Aircraft Thermal Environments, by C. L. Taylor, University of California, Los Angeles, Calif. 1956 ASME Aviation Conference paper No. **56—AV-3** (multilithographed; to be published in Trans. ASME; available to Jan. 1, 1957).

The physiological and biophysical basis of human response to high environmental temperatures is discussed, and the state of adaptation, whether compensated or noncompensated, is graphically displayed.

In the range of compensation, both comfort and noncomfort steady states are to be expected. Depending upon the clothing worn, and the conditions of altitude, humidity, etc., the upper margin of the compensible zone is about 110 F.

The man-clothing-environment system has been analyzed by use of biophysical heat-transfer formulations which take into account experimentally determined body heat and temperature parameters. Chief among these is a heat-storage index which is calculable from the conditions of environment and clothing. Time-tolerance and time-performance relationships with the heat-storage index have been experimentally determined.

A prediction chart has been prepared for the use of aircraft designers, which permits a rapid calculation of tolerance and performance times for a wide range of environment and clothing conditions.

Drag-Turbine Performance, by O. E. Baljé, Mem. ASME, Hydro-Aire, Inc., Burbank, Calif. 1956 ASME Aviation Conference paper No. **56—AV-6** (multilithographed; to be published in Trans. ASME; available to Jan. 1, 1957).

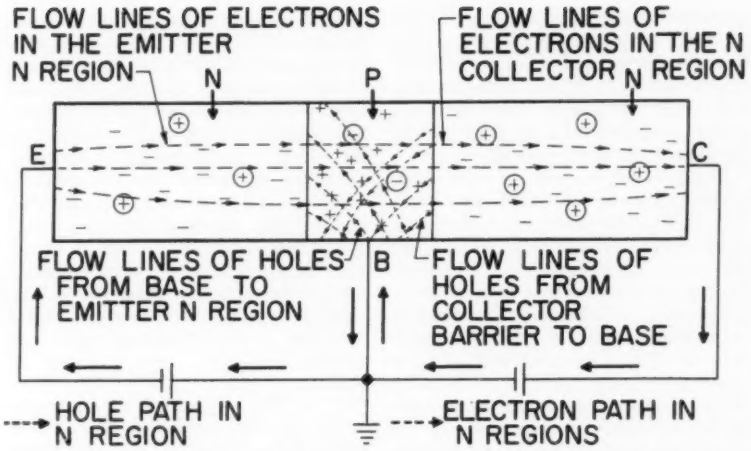
A PREVIOUS paper presented some basic considerations concerning the principal features of drag turbines. The conclusion was derived that this turbine type offers particular advantages for small accessory power units, where low bulk, simplicity, and high reliability are most desirable. This application was suggested since drag turbines exhibit peak efficiencies at low speeds; i.e., low u/c_{th} values where u denotes the wheel tip speed and c_{th} the spouting velocity of the gas. Presently available test data show peak efficiencies of about 35 per cent.

Further studies reveal that higher efficiencies can be obtained so that this turbine type will not be restricted to applications where efficiencies are of secondary importance, but also will show merit in cases where an effective energy utilization is more critical.

In this paper a simplified theory is presented which enables fair predictions of drag-turbine performance for compressible as well as incompressible media, accounting for the influence of design geometries on performance range and peak efficiency.

Modernization of Air-Borne Electronic Equipment by the Use of Transistors, by P. D. Davis, Jr., and J. W. Lacy, Mem. ASME, Texas Instruments, Inc., Dallas, Texas. 1956 ASME Aviation Conference paper No. **56—AV-7** (multilithographed; available to Jan. 1, 1957).

RECENT developments in transistors have permitted their use in some of the latest air-borne electronic equipment. The continued improvement and increased usage of transistors will allow considerable savings in equipment weight, space, power, and cooling requirements, in addition to a substantial increase in reliability. This paper contains a brief description of the operation of transistors and their advantages and also contains examples of current transistor applications in air-borne equipment.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An n-p-n transistor consists of two n-type regions separated by a thin p-type region in a small bar cut from a single crystal of silicon or germanium

Devices in current production in the United States fall into several categories as to material and method of manufacture but virtually all are known as junction transistors. Materials used are either germanium or silicon. Germanium units are the most common and are cheaper, but have a disadvantage in that they have a relatively low temperature limitation, generally about 75 C ambient. Silicon units can be operated up to 150 C with no ill effects.

During the past two years, great strides have been made in the application of transistors in both commercial and military equipments. Naturally, because transistorized equipments are so much smaller in size, lighter in weight, and consume so little power as compared to equivalent vacuum-tube designs, they are highly desirable for use in aircraft.

Especially suited for transistorization is the interphone, or intercommunication which is a necessity in all multiplace military aircraft. The heart of any interphone system is the amplifying circuits. One design of a transistorized interphone amplifier is only about $1/10$ the size of the vacuum tube model it replaces and weighs approximately $1/4$ as much. Of equal importance is its relative power consumption. This amplifier, which uses four silicon transistors, requires only $2^1/_2$ watts of power, whereas its vacuum-tube predecessor used over 8 watts.

In high-speed military aircraft, the navigation and radar fire-control problems are very complex. As a result, more and more electronic computers are required in such aircraft. Because computers are multistage devices, vacuum-tube circuit designs require considerable space and weight and large amounts of aircraft electrical power. Transistors are particularly adaptable to many computer circuits. One example where transistors can be used is in timing circuits such as binary counters.

An even more practical use of transistors is in a computer timing circuit. Instead of using individual plug-in stages, 9 stages are all built together on a printed board only $3^1/_4 \times 4^1/_2$ in.

In addition, transistors capable of amplifying the higher ratio frequencies have been developed. Transistorized amplifiers have been designed which are capable of replacing the vacuum tube IF amplifiers in radar and VHF radio communications and navigation equipment.

In the matter of a very few years, power transistors will be available which can replace many vacuum tubes in power circuits such as modulators, radar-indicator sweep generators, and amplifiers, etc.

High-Temperature Aircraft Hydraulics, by G. R. Keller, North American Aviation, Inc., Downey, Calif. 1956 ASME Aviation Conference paper No. **56—AV-5** (multilithographed; available to Jan. 1, 1957).

THERE have been marked advances in the technology of high-temperature aircraft hydraulics in the past few years. Many hours of actual high-temperature

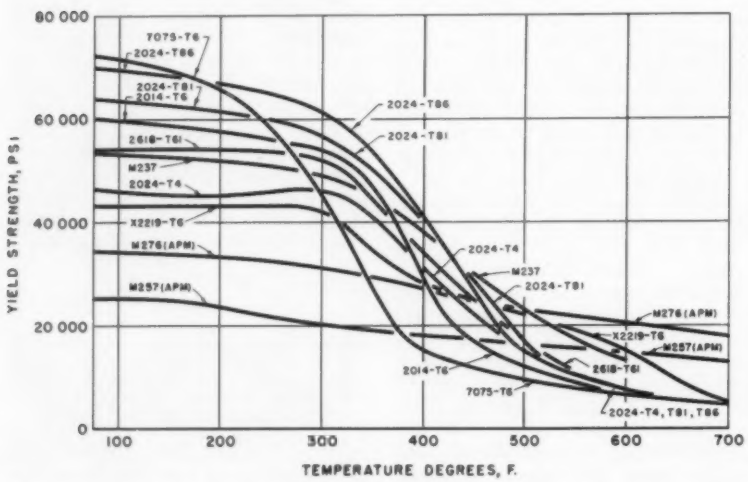
operation have been logged. Fluids for these services are no longer experimental. Pumps, relief valves, servovalves, airless reservoirs, accumulators, and other components have all been tested successfully, if not service-proved, at temperatures in excess of 400 F.

Much, of course, remains to be done. Perhaps the outstanding immediate problem is the further development of reliable dynamic seals for 400 F service. Where such seals are not available, high-temperature hydraulic-system maintenance—particularly in inhabited aircraft—will be an extremely costly and time-consuming operation. Tube fittings need to be examined closely to determine the effect of broad temperature variations on both flared and flareless connections. No really suitable flexible hose is commercially available for use at temperatures above 250 F. Presently known lubrication greases for rod end bearings refuse to stay in place when heated. All these difficulties, and many others, must have solutions before truly operational 400 F systems can exist. However, the advances that have been made are so great that all these problems appear hopeful of solution and the day of the truly high-temperature operational hydraulic system seems to be dawning for the aircraft industry.

Aluminum Alloys for Elevated-Temperature Applications, by E. H. Dix, Jr., Aluminum Company of America, New Kensington, Pa. 1956 ASME Aviation Conference paper No. **56—AV-8** (multilithographed; available to Jan. 1, 1957).

This paper presents data on one new casting alloy, two new wrought alloys, and two APM products, as well as on a forging alloy which has not been used for airframe structures. It has been indicated that the high-strength aluminum-zinc-magnesium-copper alloys as typified by 7075-T6 are not efficient for airframe structures at temperatures above 250 F. The standard airframe alloys, 2024-T4 and 2014-T6, appear to be appropriate for temperatures in the range of 250 to 350 F, alloy 2014-T6 having a small advantage in tensile, stress-rupture, and creep strengths and 2024-T4 in fatigue strength. Considerable advantage in tensile properties, however, can be realized even up to 450 F by using 2024-T81 or -T86. Within this same range of temperature, alloy 2618-T61 deserves consideration, but its possible choice depends on the specific governing property and the time. In the temperature range 350 to 500 F, the experimental alloy, M237, should be considered where strength, creep, stress - rupture, and fatigue properties are important. From 500 to 650 F, the alloy X2219-T6 has some important advantages in creep and stress rupture. Above 600 F, the APM products show marked superiority over any of the conventionally produced alloys.

It is important both to the aircraft industry and to the aluminum industry that new alloys mentioned should be evaluated promptly to determine whether or not their properties justify their commercial production for use for airframe structures. The new casting alloy XA140 is at present available only for experimental use. Alloy 2618 is now available as forgings only. Alloy X2219 is also available for experimental use in the form of sheet plate extrusions and forgings. Alloy M237 is still further from commercialization, but the aluminum industry would like to know whether its elevated-temperature characteristics would justify its development for sheet, alclad plate, extrusions, and possibly forgings.



Yield strength of wrought alloys at elevated temperatures after 100 hours at temperature

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Some Structural Penalties Associated With Thermal Flight, by J. W. Mar and L. A. Schmit, Massachusetts Institute of Technology, Cambridge, Mass. 1956 ASME Aviation Conference paper No. **56—AV-9** (multilithographed; to be published in Trans. ASME; available to Jan. 1, 1957).

The structural design of aircraft takes on an added dimension when thermal flight is encountered.

This paper investigates the short-time static strength of the structure as it is subjected to the combined action of maneuvering loads and internal heat flow.

Thermal stresses are induced by temperature gradients as the heat energy generated in the boundary layer is transferred to the interior of the structure. The magnitude of the thermal stresses depends upon the severity of the temperature gradients. If the aircraft changes its speed and altitude so that changes in the boundary layer occur in a relatively gradual manner, then small thermal stresses can be expected. If the converse is true, then large thermal stresses can be expected. Consequently, it is the transient nature of any given flight mission which accentuates the thermal effects on the static strength. The structural designer must therefore investigate those flight missions which are the most highly transient. Whether or not these are used as the basis for design depends upon the weight penalties which must be paid as measured against the decrease in flight-mission capabilities.

The Application of a New Structural Index to Compare Titanium Alloys With Other Materials in Airframe Structures, by L. R. Jackson, Mem. ASME, and S. A. Gordon, Battelle Memorial Institute, Columbus, Ohio. 1956 ASME Aviation Conference paper No. **56—AV-10** (multilithographed; to be published in Trans. ASME; available to Jan. 1, 1957).

The evaluation of structual materials for airframes is based on the strength/density ratio or, more precisely, the ultimate strength/density ratio, the compressive yield strength/density ratio, and the structural indexes for plates and columns. The structural indexes de-

veloped for plate elements have, in the past, been based on the formula

$$S_e = \frac{1}{K^{1/4}}\left[\frac{12\,(1-\mu^2)}{\pi^2}\right]^{1/4}\frac{F_{bc}^{3/4}}{E_r^{1/4}}$$

The application of this relationship to complex sections depends on the weighted average of the various plate elements that constitute the section and on the proper selection of their end fixities. Past experience indicates that this method is often unreliable and does not predict the failing load of the section, since the formula predicts only the stress at which the first buckle occurs in each respective element. A new method of predicting the failing load of a section in compression was suggested in 1954 by R. A. Needham. His method has been used to develop a new structural index for the evaluation of the strength/density ratio of materials in compression. In this report, this new structural index

$$S_e = \frac{2.56\,F_{cc}^{2.18}}{(\eta F_{cy} E)\,0.59}$$

is compared with the results of compression tests on aluminum sections at room temperature, and similar tests on titanium-alloy angles and channels at room and elevated temperatures. The aluminum test data are from Needham's report; the titanium-alloy test data were supplied by Convair (San Diego) and Boeing (Seattle). Excellent agreement is obtained in all cases. It is believed that the new structural index will provide a reliable method of evaluating the elevated-temperature performance of materials such as titanium, in comparison with other materials, when only the compressive stress-strain curves are available at each temperature.

Optimum Stresses of Structural Elements at Elevated Temperatures, by A. Schnitt and H. S. Wolko, Bell Aircraft Corporation, Buffalo, N. Y. 1956 ASME Aviation Conference paper No. **56—AV-11** (multilithographed; to be published in Trans. ASME; available to Jan. 1, 1957).

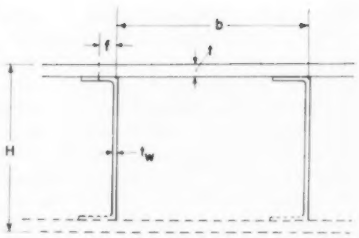
A METHOD is developed by which optimum-stress curves for a given material at any temperature may be calculated from the room-temperature optimum-stress curves for a different material. The only data required to perform this transformation are stress-strain curves of both materials. As examples, optimum-stress envelopes are obtained for wide columns and multiweb beams over a wide range of temperatures. Relations are developed between the properties of optimized elements of different materials so that the detailed dimensions of any element may be calculated by considering a properly selected equivalent aluminum element. An approximate procedure is developed for the determination of maximum life when creep is significant. The method is then extended so as to permit comparison of unprotected structures with insulated and cooled structures on the basis of minimum weight-strength and as a function of temperature and exposure time. Thus these developments lead to a systematic procedure by which the optimum structural arrangement and material may be selected for a given loading and known thermal environment.

Thermostructural Efficiencies of Compression Elements and Materials, by George Gerard, Mem. ASME, New York University, New York, N. Y. 1956 ASME Aviation Conference paper No. **56—AV-12** (multilithographed; to be published in Trans. ASME; available to Jan. 1, 1957).

MINIMUM weight equations for failure of solid and wide columns, plates and plate assemblies (crippling), and optimum stringer panels are presented in terms of suitable structural loading and material efficiency parameters. From these equations the comparative structural efficiency of plates and stringer panels was investigated. Similarly, the comparative efficiency of various materials was studied for elevated-temperature stringer-panel applications. By analytically determining the optimum spacing of ribs or webs in stringer panel-rib or multiweb construction, respectively, a composite structure of minimum weight is obtained. For such structures, the structural loading and material efficiency parameters are generally different than those obtained for the individual elements. Typical results are presented for composite structures and some general considerations are presented for selection of materials for thermal-flight aircraft.

Weight-Efficiency Analysis of Thin-Wing Construction, by R. A. Anderson, National Advisory Committee for Aeronautics, Langley Field, Va. 1956 ASME Aviation Conference paper No. **56—AV-13** (multilithographed; to be published in Trans. ASME; available to Jan. 1, 1957).

SOME of the factors that determine the weight of multiweb thin-wing construction are reviewed with the intention of directing attention toward developments that will lead to further improvements in weight efficiency. One of these is the use of a corrugated web system which can provide not only a stiff deflectional



Cross section of multiweb-wing structure

support to the cover skins but also a high degree of rotational fixity to the skin panels. An associated problem is the provision of simple attachment members which are light in weight and capable of utilizing the web stiffness to support the cover skins.

For structures requiring temperature-resistant materials, the use of sandwich-plate construction will greatly reduce the buckling instability problems inherent with the high density of these materials. The total sandwich thickness need not be greater than 10 times the total face-plate thickness for this to be accomplished efficiently. The calculations presented for stainless-steel sandwich of current manufacturing capability indicate that even at room temperature multiweb-wing construction of such material is competitive in weight with conventional aluminum-alloy structure. Because sandwich construction permits efficient utilization of the strength of presently available temperature-resistant materials, further improvement in weight efficiency largely depends upon any improvement that can be made in the yield-strength-to-density ratio of such materials.

Design Criteria for Heated Aircraft Structures, by Robert Goldin, Bell Aircraft Corporation, Buffalo, N. Y. 1956 ASME Aviation Conference paper No. **56—AV-14** (multilithographed; to be published in Trans. ASME; available to Jan. 1, 1957).

ENGINEERING considerations which constitute structural criteria are briefly reviewed, and the use of "safety factor" in the "working-stress" approach is compared with its use in the "limit-load" design concept. It is recalled that in current aircraft-design practice, primary "limit conditions" are arbitrarily formulated on the basis of not combining two or more maximum severity conditions. Aerodynamic heating superimposes: (*a*) maximum temperature, (*b*) temperature gradients, and (*c*) creep life as additional parameters which severely influence design.

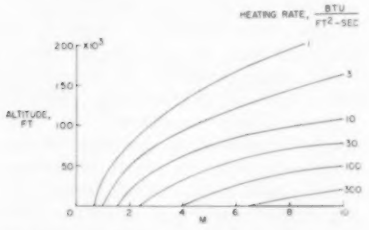
The design-criteria problem is to define realistic combinations of these with each of the previous key parameters used in aircraft design. The possible design combinations are vastly increased, and it is contended that only a criteria framework and basic philosophy can be generally applicable to all heated aircraft. Proposals relative to safety factors, creation of limit load-and-temperature-condition combinations, and how to introduce creep life are presented, together with illustrative examples of criteria for two types of aircraft.

Some NACA Research on the Effect of Transient Heating on Aircraft Structures, by J. E. Duberg, National Advisory Committee for Aeronautics, Langley Field, Va. 1956 ASME Aviation Conference paper No. **56—AV-16** (multilithographed; to be published in Trans. ASME; available to Jan. 1, 1957).

It is generally recognized that the most important effect of aerodynamic heating is the existence of high temperature in the airframe. These high temperatures depreciate the structural properties of the materials of which the aircraft is made and, in general, lead to increased structural weight. It is also true that during the heating process there is a nonuniform distribution of temperature throughout the structure. The external surfaces heat the most rapidly and the internal structure lags behind an amount dependent upon the exact details of the construction. There arises from the nonuniform temperature distributions a distribution of thermal stresses.

The heating which a particular aircraft will experience depends upon its flight plan. It is possible, however, to make an estimate of the maximum heating an aircraft might experience at a given Mach number and altitude by computing the initial heating rate associated with an instantaneous acceleration to that Mach number at that altitude.

This paper discusses some of the techniques which the NACA has developed for producing such heating rates and to illustrate their applications by presenting the results of some tests.



Maximum heating rate as a function of altitude and Mach number for an instantaneously accelerated wing section

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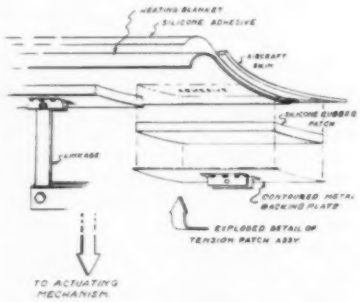
Aircraft Structural Testing Techniques at Elevated Temperatures, by R. B. Baird and R. C. Brouns, Wright-Patterson Air Force Base, Ohio. 1956 ASME Aviation Conference paper No. **56—AV-15** (multilithographed; to be published in Trans. ASME; available to Jan. 1, 1957).

This paper reviews some of the test-system requirements and problems associated with structural testing of aircraft at elevated temperatures. A brief description of loading methods used for the past generation of aircraft is presented. The requirements of an elevated-temperature test facility are established on the basis of the need for simultaneous testing and loading of an aircraft structure.



Exploded view of heating and loading system using heating blankets

Heating devices such as heating blankets, strip heaters, film heaters, induction coils, radiant-heating coils, and infrared lamps, which are being investigated by the Wright Air Development Center, are discussed in relationship to methods of attaching loads. Complications caused by simultaneous heating and loading are illustrated by a discussion of two structural tests performed at the Wright Air Development Center. A description is also given of an electronic computer developed to program the aerodynamic heating of a structure.

Utilization of Solar Furnaces in High-Temperature Research, by Pol Duwez, California Institute of Technology, Pasadena, Calif. 1956 ASME Aviation Conference paper No. **56—AV-17** (multilithographed; to be published in Trans. ASME; available to Jan. 1, 1957).

Solar furnaces may be used for fundamental research on high-temperature materials or for studying the effect of high heat fluxes on materials and structures. For high-temperature material research, maximum performances in reaching the highest possible temperature are required. A research furnace for this purpose may be relatively small (up to 10 ft at present and perhaps up to 15 ft in the future) with a sun's image less than 1 in. in diam. In the existing furnaces, it appears that temperatures up to about 3500 K have been reached. Many of the most interesting materials which cannot be melted in more conventional laboratory furnaces would require still higher temperatures. The value of solar furnaces as research tools would be greatly increased if they could produce temperatures up to 4600 K. As shown in this paper, this goal can be achieved only by increasing the optical quality of the reflecting parabolic mirror. It is believed that there is no physical limitation in building such high-quality mirrors, but their cost might be very high.

High temperature in a solar furnace means high heat flux, and the high-performance furnace capable of reaching 4600 K would have a flux of 37,500 cal/cm²/min (2300 Btu/ft²/sec). Such a small furnace, however, with a sun's image diameter equal at the most to 1 in. may not be of great interest to the aircraft structural engineer. A high heat-flux area of at least 6 in. and possibly 12 in. (this would mean a 200 ft parabolic mirror) may be required before solar furnaces are considered useful tools in solving structural problems associated with high-speed aircraft. For large furnaces of this type, the present state of the art indicates that the maximum flux attainable is about 9000 cal/cm²/min (550 Btu/ft²/sec). It would not be wise to say that these performances cannot be improved by better design, but because of the complete lack of experience in solar-furnace construction in this country, it is probable that many costly and frustrating attempts to build large high-performance furnaces will be made before successful results are obtained.

Discussion on Safety-Factor Requirements for Supersonic Aircraft Structures, by G. M. Goldman, Avco Manufacturing Corporation, Stratford, Conn. 1956 ASME Aviation Conference paper No. **56—AV-18** (multilithographed; to be published in Trans. ASME; available to Jan. 1, 1957).

This paper deals with the safety-factor aspects of design rather than any discussion of design-criteria conditions. It covers essential items concerning certain present safety-factor aspects, new problems caused by the advent of heated aircraft structures, and the ideas of Air Force

engineers as to the procedure necessary to provide adequate safety reserves in the design of new high-speed aircraft.

Oronite High-Temperature Hydraulic Fluids 8200 and 8515, by N. W. Furby and R. L. Peeler, California Research Corporation, Richmond, Calif., and R. I. Stirton, Oronite Chemical Company, San Francisco, Calif. 1956 ASME Aviation Conference paper No. **56—AV-22** (multilithographed; to be published in Trans. ASME; available to Jan. 1, 1957).

THIS paper presents data on two outstanding fluids developed for use over a wide temperature range. These fluids, Oronite high-temperature hydraulic fluids 8200 and 8515, have pushed top operating temperatures upward some 300 F without reducing performance at low temperatures.

Oronite high-temperature hydraulic fluids 8200 and 8515 are outstanding in the following properties important for operation of high-speed aircraft and guided missiles: Viscosity at high temperatures, viscosity index, shear stability, volatility, oxidation and corrosion stability, thermal stability.

Hydrolytic stability of the Oronite fluids is excellent as compared to many silicate-ester-base fluids and lubricants. Compatibility with 5606 fluid is good, and rubber compounds which appear satisfactory are available. Data on performance in pumps at high temperatures indicate satisfactory performance in pumps designed for these temperatures. Foaming is greater than for 5606 fluid, but this does not appear to be a problem in well-designed systems.

Oronite high-temperature hydraulic fluids 8200 and 8515 are now available commercially. It is believed that they will provide exceptional service over a wide temperature range and will contribute to the success of supersonic flight.

A Comparison of Hydraulic and Pneumatic Accessory-Power Generation, by E. I. Brown, Mem. ASME, Vickers Incorporated, El Segundo, Calif. 1956 ASME Aviation Conference paper No. **56—AV-23** (multilithographed; to be published in Trans. ASME; available to Jan. 1, 1957).

AIRCRAFT accessory-power transmission systems utilizing hydraulic pumps and motors are shown to be more efficient than those using pneumatic turbines driven by compressor bleed. The hydraulic system shows significant advantages in terms of both engine maximum thrust and cruise fuel consumption. A convertible hydraulic unit used as a turbojet starter motor and as an engine-driven hydraulic pump offers weight and performance advantages which further increase the value of hydraulics for all aircraft accessory-power systems.

High-Temperature Problems of Air-Borne Electrical Equipment, by L. J. Lyons, Consulting Engineer, Los Angeles, Calif. 1956 ASME Aviation Conference paper No. **56—AV-25** (multilithographed; available to Jan. 1, 1957).

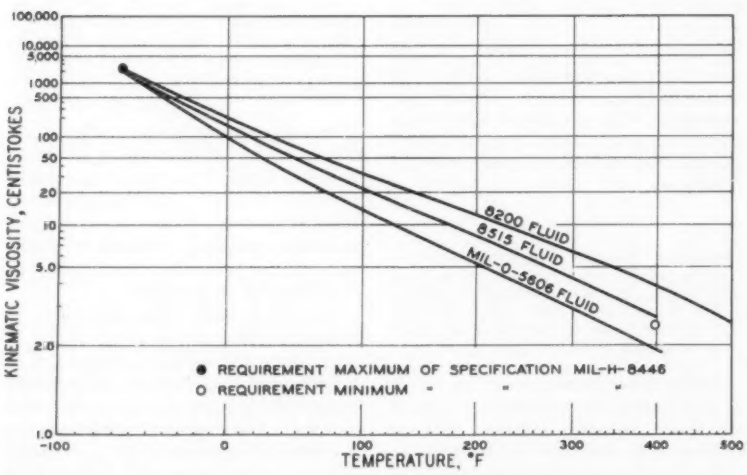
ACCORDING to this paper (1) New developments in materials and components have been raising allowable equipment operating temperatures, but they have not kept pace with the environmental temperatures associated with increased flight speeds. (2) The severe performance penalties associated with cooling systems make it necessary to engineer equipment and installations with the best possible heat-exchange "effectiveness." (3) Much effort has been put into establishing optimum conditioning systems, but equipment requirements are not known to a comparable degree of accuracy, and most equipment designs have poor heat-transfer characteristics. (4) A basic factor causing inadequate knowledge of cooling requirements is the lack of life versus temperature data for many materials and components. (5) The major factor permitting inadequate equipment design is the equipment specification, which does not properly define environmental conditions, and does not require design consistent with current material limits, current airframe performance, or improved types of cooling arrangements. (6) Forced fluid cooling will be the primary technique for some time to come, and specifications should call out coolant temperature, coolant flow rate, and coolant pressure drop.

Recent Advances in Miniature Instrument Bearing Technology, by W. M. Bergethon, New Hampshire Ball Bearings, Inc., Peterborough, N. H. 1956 ASME Aviation Conference paper No. **56—AV-28** (multilithographed; available to Jan. 1, 1957).

CURRENT requirements for miniaturization in avionics design have resulted in increased emphasis on the need for instrument bearing components of better quality than traditionally available. Miniature bearings, one of the latest developments in the instrument ball bearing industry, are discussed from the standpoint of history, manufacturing, and application techniques, and performance evaluation. Future problems are also discussed.

The Large Water-Based Transport and Its Military Uses, by Guy Mallery, Jr., Product Utilization Group Engineer, Martin-Baltimore, Md. 1956 ASME Aviation Conference paper No. **56—AV-26** (multilithographed; available to Jan. 1, 1957).

DURING the past decade there have been striking changes in the design approach to the military air transport. Initially, it was felt that a commercial airliner, with little modification, was suitable for military purposes. It was not until much later that the military transport was approached as a separate and distinct aircraft. Now, in accord with the concept of systems engineering the whole system of basing, manning, and



Oronite high-temperature hydraulic fluids—kinematic viscosity versus temperature

support is engineered as a unit along with the aircraft.

Design engineering at Martin has attempted to place the maximum emphasis on the miltary utilization of a system. The design engineer must know the part played by the system in current military doctrines, and the duties it is expected to perform.

Applying these utilization studies to the transport system has led to the conclusion that there is a definite need for a large high-speed water-based aircraft.

This conclusion is based on a study of the strategic mobility role and the theater logistics role of the transport, both of which are discussed in detail in this paper.

The Technical Appraisal of the Performance of OS-45 and/or OS-45-1 High-Temperature Hydraulic Fluids, by H. S. Litzsinger and R. E. Hatton, Monsanto Chemical Company, St. Louis, Mo. 1956 ASME Aviation Conference paper No. **56—AV-21** (multilithographed; available to Jan. 1, 1957).

Of all the readily available chemical compounds, the silicate esters offer the greatest number of advantages as base stocks for high-temperature hydraulic fluids.

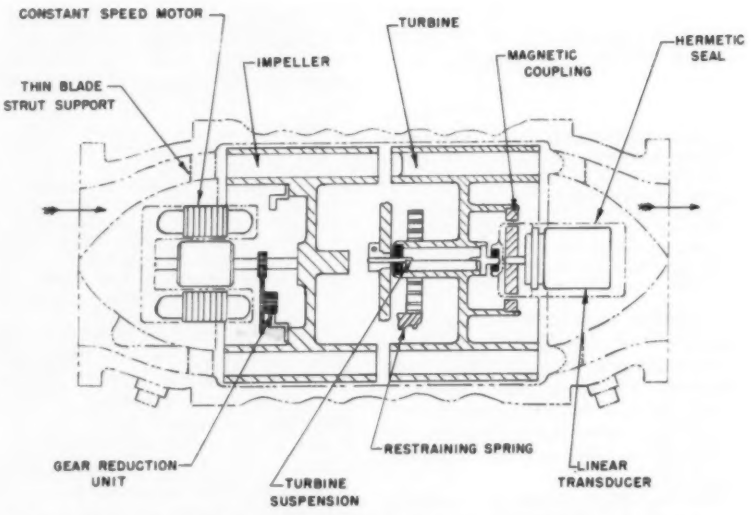
Silicate esters as represented by OS-45 and/or OS-45-1, are completely satisfactory for the forthcoming hydraulic systems, as we anticipate them today.

Silicate esters hydrolyze to form precipitates; however, the occurrence of this phenomenon in actual service has not been demonstrated to be a serious problem and the products of hydrolysis, if contamination should occur, are not abrasive.

OS-45 and OS-45-1 have been in existence and under test and evaluation by the airframe companies and component manufacturers since 1951, and today stand as the most advanced high-temperature hydraulic fluids that are offering more than satisfactory performance in hydraulic systems for supersonic aircraft and guided missiles.

Mass Flowmeter for In-Flight Refueling, by C. F. Taylor, General Electric Company, West Lynn, Mass. 1956 ASME Aviation Conference paper No. **56—AV-20** (multilithographed; to be published in Trans. ASME; available to Jan. 1, 1957).

A new mass flowmeter for in-flight refueling of jet aircraft is described. This flowmeter incorporates very large capacity in a compact rugged unit of unusually high accuracy. Other features are light weight, low-pressure drop, no rotating fluid seals, and fast response to sudden changes in fuel flow rate. This has been achieved by applying the angular momentum principle to obtain a mechanical torque that is linearly proportional to mass rate of flow.



Cross-sectional view of mass flowmeter for in-flight refueling of jet aircraft

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Controlled Gyro Tumbling by Means of a High-Angle Gimbal Stop, by Louis Curdo, General Electric Company, West Lynn, Mass. 1956 ASME Aviation Conference paper No. **56—AV-29** (multilithographed; available to Jan. 1, 1957).

With a conventional two-axis directional gyro, it is possible for the heading indication in horizontal flight to be in error by 180 deg after certain aircraft maneuvers. The use of a high-angle gimbal stop eliminates this kind of error by causing a type of controlled gyro tumbling. Controlled tumbling of this sort, however, introduces some error in the heading, because it changes the position of the spin axis. This paper gives some insight into the motion and a means of estimating the effects of varying parameters.

Measuring Ramjet Tailpipe Temperatures, by Philip J. Valentine and Edward P. French, Marquardt Aircraft Company, Van Nuys, Calif. 1956 ASME Aviation Conference paper No. **56—AV-30** (multilithographed; available to Jan. 1, 1957).

Temperature measurement on ramjet tailpipes requires instruments which are quite rugged, accurate, fast in response, and remotely indicating.

Five systems of measurement are considered: thermocouples, optical pyrometers, metallography, temperature-sensitive paints, and infrared photography. In the authors' experience the latter two are most generally useful for this application.

Temperature-sensitive paints change color at specified temperatures and may be used to determine what temperatures were reached at various portions of a tailpipe.

The tailpipe may also be photographed on infrared film, the image density on the negative being a function of the temperature of the tailpipe.

Management

Applying Linear Programming to Inventory Planning in a Seasonal Market —A Case Study, by D. W. Moffett, Methods Engineering Council, Pittsburgh, Pa. 1956 ASME Engineering Management Conference paper No. **56—MGT-1** (in type; to be published in Trans. ASME; available to Jan. 1, 1957).

Linear programming is a mathematical technique for determining an optimum of action when the situation is affected by many variables. In several instances, linear programming has been applied to production-planning problems to determine a most profitable, least costly, or most productive program.

This paper describes an application of linear programming to the problem of providing stable levels of employment in a plant producing parts for an assembly line which operates at a seasonally variable rate. Linear programming makes it possible to formulate a plan for maintaining stable production levels with minimum cost.

Availability List of Unpublished ASME Papers

A NUMBER of papers and reports were presented at ASME Meetings which were not preprinted or published. Manuscript copies of these copies are on file for reference purposes in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y. Photostatic copies of these unpublished papers may be secured from the Library at the rate of 40 cents per page. The following papers recently have been placed on file in the Engineering Societies Library:

1955 Annual Meeting

The Component Parts That Make Up Engineering Cost, by F. W. Argue

1956 Engineering Management Conference

The Effective Use of Engineers in Design, by B. C. Boulton

The Engineer In a Professional Status, by R. D. Woodson

Effective Use of Engineering Skill in Manufacturing, by R. J. Emmert

Developing the Creative Instinct, by J. R. Brand

The Training Stage After Graduation, by G. D. Lobingier

Effective Utilization of Engineering Manpower in Research, by H. R. Kemmerer

1956 Aviation Conference

MATS Intercontinental Movement of Supplies From the Aerial Ports Into the Zone of Communications, by D. O. Darrow

The Value of Airlift in Defensive, Local, or Peripheral Wars After 1960, by S. E. Eastman

Airlift Within A.M.C., by R. L. Winn

Supersonic Ramjet Controls and the Thermal Barrier, by R. K. Lowry and W. P. Boardman

Air Freight's Iron Curtain, by T. J. Harris

Performance and Design Considerations for Turbojet Engines Operating in the Thermal-Barrier Region, by R. E. Weiler

Effect of Supersonic Flight on Jet Engine Design, by W. J. Durkin and D. C. Goldberg

1956 Spring Meeting

Residual Stresses in Cylindrical Specimens, by T. C. Huang

Building a Professional Future, by R. F. Steidel, Jr.

Progress in the Machining of Integrally Stiffened Structures From Plate, by J. C. Borger

Particle-Board Manufacture (Mechanization), by D. E. Schubert and N. E. Nelson

Spreader Stoker Firing of Waste Wood in a Central-Heating Plant, by R. W. Beckley

Meteorological Factors in Site Selection, by G. R. Hilst and J. J. Fuquay

Kilns for Drying Lumber—Some Aspects of Design, by A. C. Knauss

Barking Slabs and Logs in the Northwest, by Thomas R. Miles

Professional Development—The Importance of Early Planning, by D. W. McLenegan

The Materials-Testing Reactor—Operating Characteristics and Experimental Testing, by J. R. Huffman

ASME Transactions

for May, 1956

THE May, 1956, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers), contains the following technical papers:

Symposium on Design for and Operating Experience With Outdoor Power Plants, by J. N. Landis.

Flow in Corners of Passages With Noncircular Cross Sections, by E. R. G. Eckert and T. F. Irvine, Jr.

Laminar Pipe Flow With Injection and Suction Through a Porous Wall, by S. W. Yuan and A. Finkelstein.

Radiation Analysis by the Network Method, by A. K. Oppenheim. (54—A-75)

Self-Excited Vibrations of Systems With Two Degrees of Freedom, by E. Salgé. (54—A-204)

A New Method of Evaluating Dynamic Response of Counterflow and Parallel-Flow Heat Exchangers, by H. M. Paynter and Yasundo Takahashi. (55—SA-50)

The Dynamic Response of Industrial Thermometers in Wells, by T. C. Linahan. (55—SA-52)

Flow of a Compressible Fluid in a Thin Passage, by S. K. Grinnell. (55—SA-13)

The Effect of Oil-Column Acoustic Resonance on Hydraulic Valve "Squeal," by F. W. Ainsworth. (55—SA-14)

On the Maximum and Minimum Velocities and the Accelerations in Four-Link Mechanisms, by F. Freudenstein. (55—SA-20)

Long-Shoe Block Brake With Floating Anchor, by M. F. Spotts. (55—SA-21)

Determination of Radius of Curvature for Radial and Swinging-Follower Cam Systems, by M. Kloomok and R. V. Muffley. (55—SA-29)

Determination of Pressure Angles for Swinging-Follower Cam Systems, by M. Kloomok and R. V. Muffley. (55—SA-38)

The Relation Between Grinding Conditions and Thermal Damage in the Workpiece, by R. S. Hahn. (55—SA-60)

Measuring the Thermal Diffusivity of Metals at Elevated Temperatures, by M. A. El-Hifni and B. T. Chao. (55—SA-36)

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Comments on Papers

Including Letters From Readers on Miscellaneous Subjects

Industrial Diesel-Power Units

Comment by Ralf Ottesen[1]

It was interesting to see in this excellent paper[2] reference to the old hot-bulb diesel engines of 30 years ago and to note the relation of their combustion systems with those of some modern designs, such as the MAN Whisper engine and the Ricardo "Comet" engine. In his description of their combustion systems the author uses the term "surface ignition." At the same time he reveals tests conducted by Prof. Carl J. Vogt and Professor Davies whose experiments induced them to believe that ignition in our internal-combustion engines occurs in the vapor phase and not in the liquid phase. Another point of great significance is the statement that ignition starts close to the orifice leading from the precombustion chamber to the main combustion chamber of the engine.

Speaking of surface ignition, another possible influence should be pointed out which enters the picture in so far as the very beginning of ignition is concerned. Assuming that ignition starts in the vapor phase and the surface heat transmitted from the surrounding member of the combustion chamber has natural influence on the start of ignition, the writer finds it necessary to stress the influence of the catalytic effect of the material as a surface heat carrier. Tests conducted over a number of years, primarily in Norway, on low-compression diesel engines have revealed that there is a definite catalytic influence from the surrounding walls.

While the design of these precombustion chambers basically is similar to that shown in Fig. 2 of the paper, the following improvements have been made in recent years: The compression ratio does not exceed 7.5, which puts these engines still into the low-pressure field. The walls surrounding the precombustion bulb are completely cooled and are made of cast iron. When running at normal load the ignition in these engines is performed in the following way:

A dense fuel charge is directed toward the throat between precombustion and the main combustion chamber. Indicator diagrams where a high degree of accuracy was observed show that ignition starts in the neighborhood of the throat, apparently caused by some droplets reaching the hot walls which convert them into some state of vaporization. In order to maintain a steady state of heat level, hot-spot members are arranged in the precombustion bulb in different ways. They can consist of inserted thick-walled rings, a husky helical spring with only a few windings penetrating into the path of the ignition charge, or an alloyed-steel tongue reaching into the neighborhood of the ignition charge. Those designs show that every attempt is made to reach the fuel droplets by means of a surface-heated member. Further tests have shown that the material used in these surface-heated members is of great importance, which is believed to be due to the catalytic influence of the special material employed. Cast-iron and steel alloys containing a high percentage of nickel have good catalytic properties. Low-carbon steels, however, show an inferior catalytic reaction. This fact established by long experience supports the author's statement that ignition begins as soon as some of the droplets are converted into the vapor stage.

Another point worth remembering is the fact that modern low-pressure diesel engines even operate satisfactorily when the walls subject to surface heat are relatively cold which under ordinary circumstances would prevent this type of engine from igniting at all.

As to ignition qualities, the engines mentioned behave exactly like the diesel engine, and the shape of the diagrams is exactly the same as those found in diesels. The same ignition lag is seen, but the combustion pressure is considerably lower.

Further work in Norway is in progress to modify the familiar hot-bulb chamber toward a more open design which brings these engines closer to direct-injection engines. Also, it should be mentioned that the Pintaux nozzle was tested with promising results and might become contributory to their further progress. Supercharging is also feasible.

There is one problem with these low-compression engines which has not yet been solved. All efforts to increase the compression ratio above 7.5 have failed completely, and there appears to be a range between 8 and 11 where combustion is unstable, noisy, and inefficient. The author's comments on this point would be appreciated.

[1] Mechanical Engineer, Ingersoll-Rand Company, Painted Post, N. Y. Affiliate ASME.

[2] "Analysis of Development Trends in Industrial Diesel-Power Units," by C. G. A. Rosen, Mechanical Engineering, vol. 77, December, 1955, pp. 1065–1070.

Author's Closure

Mr. Ottesen's remarks are of interest and his veiled indication brings out a point on the virtues of lower-compression oil engines. This certainly is a means for reducing cost of manufacture and also presents a real opportunity to develop higher outputs within limited maximum combustion pressures.

The influence of wall temperatures is a factor that has been studied by some of the students at Stanford in relation to its influence on heat-transfer rates through the walls into the water jacket. A hyperbolic curve reveals some interesting connotations. The relationships, however, can be upset considerably by changing the compression ratio for a given engine from $7^1/_2$ to 10. The answer to this problem is not known to the author but the results indicate that the characteristics are of a nonlinear function. This presents a promising opportunity for future study.

With regard to Mr. Dahlund's remarks from the floor, there appears to be a place where engineers from industry can be of considerable value in closely co-operating with the colleges of the nation. Excellent results can be obtained in research with considerable economy and effectiveness in our colleges provided the projects are properly guided. It is our job as engineers to find the opportunities to set up such projects and to assist in their guidance.

It was interesting to hear Mr. Dahlund mention the experiments they have conducted in using cells for improving mixture formation in spark-ignition engines. This further illustrates that this field is open for wider exploration.

Concerning fuels, there is need for clarification of the term heavy fuels

How heavy is heavy? We use the term in such a loose manner that a definition is sorely needed to limit its scope of meaning. Some of the refinery methods in use today produce stocks that can be considered in the category of heavy, according to certain specifications, and light when analyzed for other properties. Certain of these fuels are unusable in our present-day engines because of ignition and combustion problems. Our lack of understanding of the factors involved bears further investigation. The experiments referred to in the paper illustrate one method of approaching the subject.

It is also of interest in this particular development to focus attention on the Ordnance Department's desire for engines for combat purposes which will burn a range of fuels from motor gasoline to diesel distillates. It is well known that there is a relative scale of cetane to octane; 19 cetane is within an octane range of motor fuels that can be expected to be used by military services within the next few years. The experiments illustrated indicate a possibility of consuming gasoline in diesel engines by pilot-injection methods.

C. G. A. Rosen.[3]

Reversible Pump-Turbine

Comment by Fred E. Cornwell[4]

THIS paper[5] presents a fine outline of many of the design and operating features of this unique installation. The model and prototype performance curves for the final design, of course, can only indicate the extensive investigations which terminated in the units as built.

In the early stages of analysis of the transient behavior of the unit as a pump the WR^2 had to be estimated. The normal WR^2 of either a generator or a motor of the proposed size for speeds of 300 and 257 rpm is from 750,000 to 1,000,000 lb-ft^2. Values this low, however, showed pressures below atmospheric for an appreciable portion of the tunnel discharge line following power interruption to the pump. As our normal design practices try to avoid this condition, a minimum WR^2 of about 1,500,000 lb-ft^2 was found to be desirable. When the two-speed design was decided upon, the resulting WR^2 of 3,350,000 lb-ft^2 as given by the author, far exceeded our minimum requirements.

The closure or opening time of the butterfly valve of over 3 min was necessary to prevent excessive water hammer. This closure is at a linear angular rate which simplifies the controls. The slow closure of the valve when the unit is operating as a turbine results in the high-speed rise. Since the units are designed against this speed, no special precautions need be taken against excessive reverse speed following power failure when operating as a pump.

Incidentally, the close and opening times of the butterfly and tube valves, in the line which by-passes the unit, were set so that gradients produced by operation of the valves would be less severe than those produced by operation of the pump-turbine.

Comment by William J. Rheingans[6]

The writer visited the Flat Iron Power and Pumping Plant in September, 1955, after the unit had been in operation about 19 months, and observed its performance and the starting and stopping procedures. The performance, both as a pump and as a turbine, seemed to be exceptionally quiet with nearly a complete absence of noticeable vibration and noise. This was probably partly due to the absence of movable wicket gates because the unit is operating at or near the best efficiency point with corresponding good flow patterns and low hydraulic-shock losses.

The author describes the methods used originally for starting and stopping the unit both as a pump and turbine. Actually, after the plant operators became more familiar with the performance of the unit, the methods of starting and stopping were simplified and speeded up.

Since the unit is not equipped with movable wicket gates or a governor and since the starting and stopping procedures may be of considerable interest in determining the feasibility of this type of equipment for future projects, a general description of the methods used follows.

Originally it was thought that in starting the unit as a turbine the by-pass valve of the penstock valve would have to be used for the final adjustment of speed for synchronizing. Actually, it was found that the main penstock valve can be manipulated for this purpose and that the unit can be put on the line 4 min 10 sec after starting to open this valve. It is possible to bring the speed of the unit up so gradually, and it holds so steady that actual synchronization is no problem.

It also was found that owing to the construction of the generator-motor, the pull-in method of starting the unit as a turbine can be used. Using this method, the penstock valve is opened a predetermined amount. When the unit reaches 200 rpm (normal is 257 rpm) the circuit breakers are closed, and the opening of the penstock valve is continued. The unit reaches normal speed of 257 rpm 2 min after start of the opening of the penstock valve; 1 min 15 sec later the penstock valve is wide open and the unit is generating full load.

In the design of the unit arrangements were made so that it could be started as a pump by dewatering the runner, guide case, and scroll case up to the penstock valve. The unit would then require a low starting torque and thus produce little disturbance on the system. However, the electrical equipment was all designed so that the unit could be started under water. Actual practice has shown that the unit can be started readily without dewatering, especially since the disturbance on the system is less than was anticipated. This method is now being used as a standard procedure and 3 min 20 sec after commencing starting operations the penstock valve can be wide open and the unit pumping full capacity.

The shutting-down procedures when the unit is operating either as a pump or a turbine are quite simple, in that in both cases it merely consists of closing the penstock valve and opening the circuit breaker at the proper time. In both cases the unit can be brought to a complete stop about $7\frac{1}{2}$ min after the start of the shutdown operation. The closing time of the penstock valve is set at 3 min 20 sec.

Although the writer was unable to inspect the runner during his visit to the plant, the operators stated that a recent inspection had shown no signs of wear or pitting, after more than a year's operation.

It certainly is a satisfying experience when a unit of this type, which departs so radically from previous basic designs, can be placed in operation without encountering any difficulties and gives the excellent performance indicated by the field tests and operating and maintenance records.

Comment by Leslie J. Hooper[7]

It is not often that the same test methods and instruments are used to check

[3] Consulting Engineer, Caterpillar Tractor Co., Peoria, Ill. Fellow ASME.

[4] Supervisor, Mathematical Analysis Unit, Technical Engineering Analysis Section, Division of Design, Bureau of Reclamation, Denver, Colo.

[5] "Field-Testing a Reversible Pump-Turbine," by F. E. Jaski, MECHANICAL ENGINEERING, vol. 78, February, 1956, pp. 141–144.

[6] Manager Hydraulics Department, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Mem. ASME.

[7] Professor of Hydraulic Engineering, Worcester Polytechnic Institute, Worcester, Mass. Mem. ASME.

efficiencies of a pump and a turbine in the same installation. Obviously, errors favoring a pump would penalize a turbine and vice versa. For instance, if the water measurements were indicating a discharge that was too small, a turbine would appear to have a higher efficiency and a pump a lower efficiency than was actually the case.

It is therefore interesting in this case to compare the model and prototype performance for operation as a pump and as a turbine. It will be noted that the efficiency of the prototype pump was found to be about 2.0 per cent higher than the model test and the efficiency of the prototype turbine was found to be about 1.4 per cent higher than the model. Since the systematic error is only one half of the difference between these two "step-up" figures it would appear that the systematic errors had been kept to a very small figure in these efficiency tests.

Comment by Webster J. McCormack[8]

The author should be commended for his presentation of both model and prototype performance data for the Flatiron pump-turbine. It will only be after many more such comparisons of laboratory and field-performance results of pump-turbines are presented that their reliability can be established and adequate step-up formulas devised.

The paper would be more valuable if it included a description of the actual methods and apparatus used to measure the head, discharge, and power for the laboratory model, for comparison with the prototype field-test procedures. It also would be of interest to know whether the prototype runner-discharge areas are exactly proportional to the square of the prototype-model diameter ratio.

The author states that the Flatiron unit "is the first reversible pump-turbine designed, built, and installed in the United States." While this statement is strictly correct, it may be misleading. Although they were "installed" in Brazil, the writer's company "designed and built" the first reversible Kaplan (adjustable-blade) pump-turbine for the Traicao Plant in 1938 and the first reversible Francis pump-turbine for the Pedreira Plant in 1946.

The author has brought out some advantages of two-speed operation, especially the improved performance for generating at low heads. The writer would like to discuss this phase of the Flatiron design and show how an alternative feature will generally accomplish the same end results at less expense.

Consider the following three design features on the Flatiron unit:

1 No wicket gates.
2 Two-speed operation.
3 Two butterfly valves, one immediately upstream of the unit and one 6000 ft from the plant.

Compare these with a unit of the following design:

1 Wicket gates.
2 Single-speed operation.
3 One butterfly valve 6000 ft from the plant.

The electrical-machinery manufacturers have previously indicated that a two-speed motor-generator would cost from 75 to 100 per cent more than a single-speed machine. For a unit without wicket gates, a butterfly valve immediately upstream of the pump-turbine is required to synchronize and shut down the unit. A butterfly valve is used for a unit with wicket gates merely to eliminate dewatering the entire penstock for inspection and repair of the prime mover, but, since this normally would be done only once a year, most operating companies would find its use uneconomical. Wicket gates can be supplied for approximately the same price as a butterfly valve.

It becomes quite obvious, therefore, that a unit with wicket gates instead of a butterfly valve, and with the same speed of operation for both directions, will have the lower purchase price.

The next question is whether or not the single-speed unit with wicket gates can achieve the same hydraulic performance as the two-speed unit without wicket gates. Also, if not, can the additional power of the two-speed unit at the lower heads be evaluated to justify its first cost?

The answer to the first question can be either yes or no, depending upon the various factors involved. For extreme variations in head, the answer is a definite no. The second question is an answer to the first in that an evaluation of the comparative performance of the two types under the conditions of operation, considering also first costs, must be made for each specific application. It is the writer's opinion that the single-speed unit with wicket gates would win out for most of the presently proposed installations, since they do not have the extreme head variations that would justify two-speed operation.

There are many advantages of wicket gates that have been covered fairly completely in the technical press.[9] The most important is that the generating output is not solely dependent on the head at the time of operation and, therefore, a constant dependable load can be made available for any operating head by proper sizing of the unit.

Comment by G. Dugan Johnson[10]

It is well known that the most difficult item in a turbine (or pump) field test is an accurate determination of the water flow rate. In recent years the Gibson pressure-time method has been almost universally accepted in North America as the "standard" for measurement of hydraulic-turbine discharges, largely because of its relatively convenient application in strict accordance with the ASME Test Code for Hydraulic Prime Movers, as compared with the Allen salt-velocity method. However, the Gibson method has not been adapted to the measurement of pump discharge, whereas the salt-velocity method is readily adaptable to flows in either direction, as has been pointed out by the author.

Although it is usually difficult, and frequently impossible, to satisfy completely the ASME Test Code conditions for a salt-velocity test, it appears that it was feasible to conduct the Flatiron pump-turbine tests in strict accordance with the Code requirements. The only significant deviation mentioned by the author was the use of a recent innovation called a "turbulator," which "disperses the water so that a more uniform velocity is obtained across the area of the penstock at the measuring section, and gives better distribution of the brine solution as it passes the electrodes, particularly at the lower velocities."

The Code specifications for the salt-velocity method are based on tests conducted at the Alden Hydraulic Laboratory of the Worcester Polytechnic Institute in circular pipes without turbulators. It hardly seems possible that the same type of electrodes as developed for ordinary pipes would "give equal weight electrically to rings of equal area" in circular pipes with turbulators, as required by Paragraph 91 of the 1949 ASME Code. The writer would like to know what type of electrodes were used for the Flatiron tests, whether they were designed to weight properly the velocity distribution effected by the turbulator, and whether they were identical in every respect for both the pump and the turbine tests.

[8] Hydraulic Engineer, S. Morgan Smith Company, York, Pa.

[9] "Test Characteristics of a Combined Pump-Turbine Model With Wicket Gates," by R. V. Terry and F. E. Jaski, Trans. ASME, vol. 64, 1942, p. 731.

[10] Chief Hydraulic Engineer, S. Morgan Smith Company, York, Pa. Mem. ASME.

Author's Closure

Mr. Cornwell gives an interesting explanation of the extensive study of transient behavior of this unit upon power failure during a pumping or generating cycle. With the inherent *WR* squared in the two-speed generator-motor and long closing time of the butterfly valve, excessive pressure changes will not occur in the long penstock and tunnel. Such studies of transient behavior must be made to determine the proper time of closure to avoid conditions that may cause damage to the unit or penstock, or to determine if a surge tank is required.

Salt-Velocity Tests

Professor Hooper points out the importance of keeping systematic errors in a test of a reversible pump-turbine down to the lowest possible figure. The salt-velocity tests were made carefully, and are believed to be truly realistic of the actual flow through the unit in either direction. All other measurements were made with equal precision, and the errors of measurement appear very small indeed.

Mr. Rheingans mentions that the unit operates quietly, and suggests that this may be partly due to the absence of wicket gates. The author does not want the reader to conclude that wicket gates may cause a pump-turbine to be noisy. A pump-turbine with wicket gates will also operate quietly. If there is any noise, it may occur at small gate openings, just as in a conventional turbine, or at small gate openings on a pumping cycle, because the wicket gates are then at an angle not suited to the best flow to or from the runner, which causes shock losses.

Butterfly Valve Versus Wicket Gates

The unit synchronizes very smoothly by control of the butterfly valve, because there is probably better control of the speed than with wicket gates. When a unit is brought up to its no-load speed for synchronizing, it will be running at a runaway speed for each position of the butterfly-valve wicket, or in the case of wicket gates, for each opening of the wicket gates. At small openings of the butterfly valve, or at small openings of the wicket gates, there is a throttling of the flow, causing a loss of head through the butterfly valve or through the wicket gates. We must then find the correct opening of the butterfly valve or wicket gates that will produce a loss of head such that the net head between the valve and runner, or between the wicket gates and runner, will produce a runaway speed just equal to the correct speed in rpm for synchronizing the unit to the line frequency. At this valve opening or wicket-gate opening, the unit will run at constant speed as long as the head remains unchanged. When we have the correct valve or wicket-gate opening that will produce the correct speed in rpm for synchronizing, the circuit breaker can be closed, and the unit can be connected to the line in phase with the line frequency without causing any disturbance to the system. Wicket gates usually cause coarser control of this speed, because, at the small openings, a change of as little as one degree movement can make the net head on the runner go up or down considerably, and the speed will go up or down in the same proportion.

With a butterfly valve, the fixed-stay vanes are set at about the best gate opening, and the angle of attack is more suitable for the runner when it is near the synchronizing speed in rpm. A small change of the valve-wicket angle only controls the amount of water flowing, with little effect on the angle of attack on the buckets, since the valve wicket is at a great distance from the runner buckets. Thus the change in rpm and frequency is very little, and the unit can be "phased in" quite smoothly.

By-Pass Valve Control

A by-pass valve around the butterfly valve provides a micrometric control of the quantity of water flowing when synchronizing, and gives remarkably smooth control of the speed. If the by-pass is used, the butterfly-valve wicket can be opened to produce a speed 10 or 20 rpm below synchronous speed. Then the by-pass valve is opened gradually, and the speed comes up to synchronous rpm very smoothly. It can be held steady when it reaches synchronous speed for a long time, so that the synchroscope just creeps across the 12 o'clock position at the time the circuit breaker is closed. If the operator opens the by-pass too much and overshoots the correct speed, the by-pass can be closed gradually to reduce the speed back to synchronous rpm very smoothly. A motor control on the by-pass valve provides the same type of control as is standard equipment on turbine governors equipped for remote control of the wicket gates on a conventional turbine.

Model Tests

Mr. McCormack requests information about the model test in the laboratory. The test model was a horizontal unit driven by a calibrated induction motor for pumping. A hydraulic dynamometer measured the torque in the turbine tests. Head was measured by mercury manometers and calibrated pressure gage. Flow was measured by a calibrated venturi meter.

The areas between buckets of the prototype runner were measured carefully, and other check measurements also were made on the runner before it left the shop for shipment to the power plant. These check measurements showed the prototype to be a true scale step-up of the model runner, actually less than $^1/_{10}$ per cent larger than the model. The author does not consider the statement misleading that "this is the first reversible pump-turbine designed, built, and installed in the United States," since this is the first unit of this kind built and installed in this country. The author's company also designed and built two reversible pump-turbines for Pedreira and a third unit for the Edgard de Souza Plant in Brazil. The largest reversible pump-turbine in the world, just completed by the author's company, for the Tennessee Valley Authority, is now in operation at Hiwassee Dam, North Carolina.

Two-Speed Operation

Mr. McCormack seems somewhat confused by the benefits obtained in this application from two-speed operation. As explained by the paper, the improved performance from two-speed operation is obvious. In regard to the cost, the evaluation was made by the Bureau of Reclamation, and the benefits apparently justified the purchase. There are applications for single-speed and two-speed units, either with or without wicket gates, but space does not permit a discussion of their relative merits here. Each application must be studied carefully to make the proper selection. There are many hydraulic-turbine installations which have a penstock valve, as well as wicket gates. In this application, the omission of the wicket gates resulted in a distinct cost saving.

Electrodes Used in Testing

Mr. Johnson requested information about the electrodes used in the salt-velocity tests. The electrodes constituted a grid of vertical and horizontal bars spaced across the circular area to give equal weight electrically to rings of equal area of the pipe cross section. Identical electrodes were used for both the pump tests and turbine tests. At the conclusion of the pump test, they

were moved to the plant side of the brine-injection pop valves for the turbine test. The turbulator is not a recent innovation in salt-velocity tests. It has been used in the tests of the pumps on the Colorado Aqueduct of the Metropolitan Water District of California and others. Check runs were made in the turbine test, with a flow of 8 fps in the penstock with the turbulator removed. There was no significant change in the results.

The author wishes to thank the discussers for their valuable contributions to this paper.

It is hoped that future applications of the reversible pump turbine will result in many more papers and discussions of this relatively new type of hydraulic prime mover.

Frank E. Jaski.[11]

Fin Efficiency[12]

THE following nomenclature is used in this note:

A = cross-section area of a spine
C = circumference of a spine
b = surface coefficient of heat transfer
k = conductivity of fin material
$m = \sqrt{b/ky_b}$ (for a fin) $= \sqrt{bC/kA}$ (for a spine)
r = radius of a circumferential fin
x = distance from base
y_b = half thickness of base of a fin
w = height of a fin $= x_t$
θ = temperature difference between surface and ambient
ϕ = fin efficiency $= \theta_m/\theta_b$

Subscript b refers to base, m refers to integrated mean value over surface, and t refers to tip.

When it is sufficiently accurate to assume that the surface coefficient has a constant value over the surface of a fin, solutions of the differential equations can be obtained. Gardner's paper[13] shows his results together with those of earlier workers, in graphical form. That paper contains an adequate bibliography.

Often it is convenient to have the results in the form of equations rather than graphs, but the exact solutions are awkward in form and tiresome to evaluate. Fortunately, the results for fins of high efficiency can be approximated in simple algebraic form, while fins of low efficiency are of no industrial importance anyway.

The accuracy of the algebraic expressions is better than the probable accuracy of the initial assumption (that one knows b precisely, and b is constant everywhere). This holds down to about $\phi = 0.75$.

Case 1

A longitudinal fin of uniform thickness or a spine of uniform section. The tip area is assumed nonconducting; otherwise, a fictitious length may be used

$$\phi = \frac{1}{1 + \frac{m^2w^2}{3}} \quad \ldots\ldots [1]$$

$$\frac{\theta_t}{\theta_b} = \frac{1}{1 + \frac{m^2w^2}{2}} \quad \ldots\ldots [2]$$

$$\frac{\theta}{\theta_t} = 1 + \frac{m^2(w-x)^2}{2} \quad \ldots\ldots [3]$$

These equations can be derived from the series for the hyperbolic tangent and cosine.

Those below were obtained simply by fitting equations to the Gardner curves.

Case 2

A longitudinal fin of triangular section

$$\phi = \frac{1}{1 + \frac{m^2w^2}{2}} \quad \ldots\ldots [4]$$

Trapezoidal sections can be approximated by a weighted average between the results of Equations [1] and [4].

Case 3

A circumferential fin of rectangular section

$$\phi = \frac{1}{1 + \frac{m^2w^2}{3}\sqrt{(r_t/r_b)}} \quad \ldots\ldots [5]$$

Case 4

A conical spine. In the equation for m, C, and A refer to the base of the spine

$$\phi = \frac{1}{1 + 0.15\,m^2w^2} \quad \ldots\ldots [6]$$

[11] Engineer in Charge, Pump Turbines, Hydraulics Section, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Mem. ASME.

[12] A Brief Note by G. M. Dusinberre, Department of Mechanical Engineering, The Pennsylvania State University, University Park, Pa. Fellow ASME.

[13] "Efficiency of Extended Surface," by K. A. Gardner, Trans. ASME, vol. 67, November, 1945, p. 621.

Seeks Material on George H. Corliss

TO THE EDITOR:

I AM collecting material and information relative to the life and career of the late George H. Corliss in preparation for writing a biography of this distinguished Providence engineer.

If any of your readers have documents, letters, or have knowledge of material which would shed light on the life and work of Mr. Corliss, I would be grateful if they would communicate with me at Brown University Library, Providence 12, R. I.

If such documents could be loaned to me, I shall have them copied and return the originals to their owners. If, on the other hand, the owners should desire to deposit the originals with the other Corliss papers already in the Brown University Library, they will be acknowledged and cataloged and made available to scholars.

S. J. Berard.[14]

The Engineering Profession

Comment by John Robert Connelly[15]

THE December issue of MECHANICAL ENGINEERING devoted considerable space to "A Comprehensive Appraisal of the Profession,"[16] and under "News" to a proposed survey.[17]

Since the survey will cost quite a bit of money that will come out of various people's pockets, and consume quite an amount of time of highly trained people, it is appropriate to consider whether it ought to be made.

Before these questions can be answered rationally we need to review and agree on our basic philosophy of what an engineering education should be. This will reveal my age but when I was in school it was still mentioned that "education was aimed at character building and developing the ability to think." The young men brought up under that philosophy seem to have made pretty commendable engineers these past 50 years.

[14] Professor of Engineering, Brown University, Providence, R. I.

[15] Palmerton, Pa. Mem. ASME.

[16] "A Comprehensive Appraisal of the Profession—A Critical Need," by S. C. Hollister, MECHANICAL ENGINEERING, vol. 77, December, 1955, pp. 1053–1055.

[17] "Survey of Engineering Profession Proposed at 23rd Annual Meeting of ECPD," MECHANICAL ENGINEERING, vol. 77, December, 1955, p. 1144.

Whole industries have been developed without their founders having had the "benefit" of studying our modern engineering college courses.

There has been quite a change in the aim and content of the various engineering curricula and courses, particularly in the past 30 years. From the aims stated in the foregoing, a shift has taken place toward "preparing" the student for engineering, at least what the professors think engineering is or will be. From a study of the work and content of a present engineering curriculum, a person could well conclude that all graduates will be research men or designers.

It will not take a million dollars spent in a survey to establish that for every research man or designer there are scores of engineers involved in manufacture, sales, applications, installation and maintenance of the equipment developed out of the laboratory and from the drafting board. Further, that the per cent of engineers per 1000 workers is increasing in these latter categories just as surely as in the research and designer categories.

Scholastic Mortality

As long as enough young men could be found who were willing and able to take this research-design education and still fill the needs of engineering recruiting, the system has muddled along fairly well. But now shortages are beginning to appear. The statement has been made in various places that when the engineering enrollment in colleges goes over a certain figure, a substantial increase in scholastic mortality occurs. It is inferred that engineering graduates of quality have this figure as a ceiling.

Let us examine on what this increased scholastic mortality is based, particularly in mechanical engineering. Most of it occurs in the first two years of an engineering education. Modern nuclear physics and mathematics, for example, play a heavy part in this mortality. It may come as a distinct shock to the professors, but there are many able engineers who have never used the mathematics they studied in college. Further, I have known a number of engineers who were not succeeding particularly well. In no case could this failure be charged to a deficiency in mathematics or physics. (If mathematics is so valuable, why aren't the mathematicians the top engineers of our country?)

To require a subject of all students because some might use it in graduate work or in practice years later is raising an artificial requirement. How many similar artificial requirements are built into the present engineering curricula? If they were removed is it not possible the number of engineer graduates with the BS degree could be increased without increased scholastic mortality? Further artificial requirements tend to obscure the real essential of an engineering education. If a particular student desires more advanced specialized work he can take the necessary preparation without forcing it on the great majority of the undergraduates. Further, there always exists the opportunity for anyone to continue his studies by himself after graduation.

If the survey proposed should be made and result in a realistic appraisal of the field of engineering as it exists in total so that the real essential of an engineering education could be developed, the survey will be worth while. However, the engineering approach to this point would be, is that the least expensive way to find the answers?

Correction

On the cover and contents page of the April, 1956, issue of Mechanical Engineering, an error was made in the title of the leading article, "Manufacturing Synthetic Lumber in Germany," by A. Elmendorf, W. Klauditz, and A. Lühning. The word "lumber" became "rubber" with gremlinlike ease. Our faces are red, our apologies abject.

Reviews of Books

And Notes on Books Received in Engineering Societies Library

Flow Production

Principles of Mass and Flow Production. By Frank G. Woollard, with a foreword by Sir Leonard Lord. Philosophical Library, New York, N. Y.; Iliffe & Sons, Ltd., London, England, Revised edition, 1955. Cloth, $6^1/_4 \times 9^3/_4$ in., illus, figs, index, 195 pp., $7.50.

Reviewed by Jesse Huckert[1]

"Flow Production, where it is applicable, can be a major factor in increasing production since the results accruing from the adoption of this comparatively new system are little short of astounding. Indeed, it is scarcely too much to claim that this new technique is, in itself, another complete turn in the industrial revolution." So begins chapter one—"History of Flow Production."

Though designated as history, chapter one and chapter two as well, under the title "Range of Applications," serve mainly to define the differences between mass production and flow production and to emphasize that it is the principles underlying mass and flow production that have lasting interest and permanent value, not the current techniques and practices associated with them.

"Mass production implies the method of making vast quantities of similar articles—simple or complicated—by a series of individual acts which are not necessarily connected with each other. ..... Flow production, on the other hand, envisages the passage of the part from operation to operation in a direct and uninterrupted sequence."

Eighteen basic principles are listed in chapter three; namely, "(1) (*a*) Mass production demands mass consumption; (*b*) flow production requires continuity of demand; (2) The products of the system must be specialized; (3) The products of the system must be standardized; (4) The products of the system must be simplified in general and in detail; (5) All material supplies must conform to specification; (6) All supplies must be delivered to strict timetable; (7) The

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machines must be continually fed with sound material; (8) Processing must be progressive and continuous; (9) A time cycle must be set and maintained; (10) Operations must be based on motion study and time study; (11) Accuracy of work must be strictly maintained; (12) Long-term planning, based on precise knowledge, is essential; (13) Maintenance must be by anticipation—never by default; (14) Every mechanical aid must be adopted for man and machine; (15) Every activity must be studied for the economic application of power; (16) Information on costs must be promptly available; (17) Machines should be designed to suit the tasks they perform; and (18) The system of production must benefit everyone—consumers, workers and owners."

Beginning in chapter four, "Launching a New Product," the eighteen principles are expanded and illustrated. In a few chapters only one principle is treated; in others, two or three. Not in every instance is the principle, or principles, covered by a particular chapter obvious from the title of the chapter.

Chapter fifteen, "The Automatic Factory," is not confined specifically to any of the principles. Rather it aims to show how automatic transfer machines and the techniques associated with them lead toward the automatic factory. Chapter sixteen, titled "Human Relations," concludes the discussion with the last principle. Besides the line diagrams, the text is supported and illustrated with well over a hundred photogravures of machines and factory installations.

Library Services

Engineering Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

Books Received in Library

ASME Handbook: Engineering Tables. Edited by Jesse Huckert. First edition, 1956, McGraw-Hill Book Company, Inc., New York, N. Y. Various pagings, $7\frac{1}{2} \times 10\frac{1}{4}$ in., bound. $12. This is a compilation of tables of recognized design standards, often needed by engineers but not usually found in handbooks. The fifteen sections of the book group together data pertinent to the design of specific machine elements and cover such subjects as bearings, gears, cylindrical fits, springs, tubing, electric motors, and gaskets. Typical of the information given are methods for finding loads on ball bearings; data on bars and tubes suitable for reworking into gears, levers, shafts, or screws; and a table of involute functions. Each of the sections of the book is preceded by an index, and sources of tables are indicated. Previous volumes of the ASME Handbook are "Metals Engineering-Design," and "Metals Properties."

ASTE Collected Papers—1955. Technical papers and panel conferences presented at the 23rd Annual Meeting of the American Society of Tool Engineers, Detroit, Mich. Various pagings, $8\frac{1}{2} \times 11$ in., loose-leaf binding. $5. The sixteen technical papers in this volume cover a wide range of subjects including magnesium for low-cost tooling, chip breakers, twist drills, rolled flow forming of toothed parts, ceramic parts and tooling, and tooling for cold-steel extrusion. In addition, there are papers on the heat-treatment of steel and aluminum, the selection, leasing, and inspection of tools, uniterm coding of information, coding engineering drawings, automation, and the frozen-mercury process for investment castings. The panel discussions deal with plastic tooling, training of engineers in industry, management co-ordination, and quality control. A research report on temperature distribution in the workpiece completes the volume.

ASTM Standards on Petroleum Products and Lubricants, 1955. Issued annually by American Society for Testing Materials, Philadelphia, Pa. 954 p., $6 \times 8\frac{1}{8}$ in., paper. $6.50. The present issue of this compilation has been brought up to date by the addition of the following: Nine new test methods covering the effect of grease on copper, sampling LP gases, lead in new and used greases, etc.; nine revised standards, including revised ASTM-IP petroleum measurement tables; and a number of new and revised tentatives. A detailed subject index is included.

Advances in Applied Mechanics. Volume 4. Edited by H. L. Dryden, Th. von Kármán, G. Kuerti, and others. 1956, Academic Press Inc., New York, N. Y. 413 p., $6 \times 9\frac{1}{4}$ in., bound. $10. The seven lengthy papers included summarize present knowledge and recent investigations on the following subjects: the turbulent boundary layer; nonlinear elasticity; physical and statistical aspects of fatigue; three-dimensional boundary-layer theory; the dislocation theory of plasticity of metals; the Poincaré-Lighthill-Kuo method; and the concept of elastic stability. The references accompanying each paper are indexed by authors, and a subject index to the volume is provided.

Casting of Steel. Edited by W. C. Newell. 1955, Pergamon Press, Inc., New York, N. Y. 599 p., 6×10 in., bound. $15.50. Prepared by a group of authorities from the British steel-casting industry, this book provides a balanced view of the whole subject, from basic principles and their applications to practical problems in the foundry. The opening chapters deal with the properties of molten steel, solidification, the melting process, and refractories. Detailed descriptions of patternmaking, mold preparation, and of the casting process are included, with separate chapters devoted to centrifugal and investment casting. The last part of the book covers heat-treatment, properties, specifications, and testing.

Control of Nuclear Reactors and Power Plants. By M. A. Schultz. 1955, McGraw-Hill Book Company, New York, N. Y. 313 p., $6 \times 9\frac{1}{4}$ in., bound. $7.50. Basic techniques for the control of solid-fuel heterogeneous reactors are presented in this book in engineering terms and in such a manner that control systems for other types may be designed by extension of the methods treated. The first part of the book covers the physics of reactor control, the response of a reactor to various types of driving functions, derivation of the transfer function, and the reactor control-loop and its response to transient disturbances. Later chapters deal with control requirements and present practices, basic problems of plant response and programming, radiation detectors, and control of plants in start-up, operation, and shutdown. The last chapter discusses simulators for the solution of reactor-plant problems.

Directory of Steel Foundries in the United States, Canada, and Mexico. Compiled and Published by Steel Founders' Society of America, Cleveland, Ohio, 1955. 256 p., $8\frac{7}{8} \times 5\frac{7}{8}$ in., paper. $10. A guide to the latest available information on the personnel and production facilities of steel foundries, including producers of heat and corrosion-resistant steel, high manganese, investment mold, and tool-steel castings. For each foundry are given the type; size; kind of casting produced; melting, heat-treating, and special processes used; number of employees; key personnel; and, in many cases, the foundry mark. A list of U. S. Government foundries and an index of foundries by states are also included.

Economic Geography of Industrial Materials. Edited by Albert S. Carlson. Reinhold Publishing Corporation, New York, N. Y., 1956. 494 p., $6\frac{3}{4} \times 10\frac{1}{4}$ in., bound. $12.50. In this book the economic, technological, and geographic conditions of key industries are explained and analyzed to show how various factors determine the location of plants, mills, and factories for efficient production. Among the twenty industries discussed, each in a separate chapter, are the coal petroleum, electric-power, iron and steel, aluminum, copper, titanium, glass, textile, and food industries, with consideration given to such factors as climate, soil, water resources, fuels, labor, capital, and markets. Two introductory chapters deal with the influence of world population and resources on industrial development and with transportation in the United States.

Electric Generation: Hydro, Diesel and Gas Turbine Stations. By Bernhardt G. A. Skrotzki. McGraw-Hill Book Company, Inc., New York, N. Y., 1956. 458 p., $6 \times 9\frac{1}{4}$ in., bound. $8.50. One of a series of four volumes comprising the Electric Utility Library, a practical series providing a comprehensive introduction to the electric-power industry. The two thirds of the volume devoted to hydro stations deals with precipitation runoff and related topics; dams, penstocks, tunnels and other accessories; generators, transformers, buses, switches, and other equipment; and problems of operation and maintenance. One chapter is devoted to gas-turbine systems and the rest of the book to the various types of oil and gas-burning reciprocating engines and their stations.

Electronic Computers and Management Control. By George Kozmetsky and Paul

Kircher. 1956, McGraw-Hill Book Company, Inc., New York, N. Y. 296 p., 6 × 9¼ in., bound. $5. Written in nontechnical language for business executives, this book explains how computers operate, shows how they can be applied to such functions as accounting, production scheduling, or cost control, and gives information on input, processing, storage, control, and output. It deals also with the basic concepts of scientific methods for analyzing business data for management planning and control, and with the tools of the analyst—linear programming, calculus of variations, information theory, stochastic models, and so on. An appendix gives specific details of currently available commercial equipment.

Electronic Data Processing for Business and Industry. By Richard G. Canning. 1956, John Wiley & Sons, New York, N. Y. 332 p., 5⅞ × 9¼ in., bound. $7. The purpose of this book is to inform management about the nature of digital-data-processing devices and to explain how they may be applied to clerical operations. Treated in detail are characteristics of major electronic components; methods of instructing machines; the systems-engineering approach to determining company needs; the design of data-processing systems to meet specific requirements; and planning for an intermediate program. Such applications as unit control in a department store and production control in a manufacturing plant are analyzed, and systems for these operations are outlined.

Enthalpie - Entropie - Diagramme für Wasserdampf und Wasser. Edited by L. S. Dzung and W. Rohrbach (Under sponsorship of A. G. Brown, Boveri and Company.) 1955, Springer-Verlag, Berlin, Germany, 17 p., 8⅜ × 12¼ in., paper. 7.50 DM. These enthalpy-entropy diagrams for steam and water are accompanied by a brief discussion of fundamentals, methods of numerical calculation, and examples of applications. The MKSA (Georgi) system of units is used.

Failure of Machine Parts, Prevention and Cure. Edited by R. Evaldson and C. Lipson. University of Michigan Press, Ann Arbor, Mich., 1955. Various pagings, 8⅛ × 10⅞ in., paper. $10. This publication contains full summaries of the twelve lectures comprising the course presented at the University of Michigan in 1955. The lectures deal with the manner in which parts fail, causes of failure; the role of design in preventing failures, and the interpretation of failures. The following specific problem areas are also dealt with: analytical treatment of stress and strength; determination of service loads; treatment of vibration, shock, and impact; use of computing machines; treatment of metallurgy and fabrication; and control of wear. There are lists of references accompanying many of the lectures.

Handbuch der Hartmetallwerkzeuge. Volume 2. Edited by W. Dawihl and E. Dinglinger. 1956, Springer-Verlag, Berlin, Germany, 436 p., 6 × 9¼ in., bound. 34.50 DM. Volume 2 of this handbook on cemented-carbide cutting tools deals with rotary tools, metal-drawing dies, mining and diamond tools. Intended for both the student and the practical worker, the book provides detailed information on the techniques and economics of a wide range of applications of cemented carbides and industrial diamonds.

Industrial Storekeeping Manual. By Benjamin Melnitsky. 1956, Chilton Company, Philadelphia, Pa., 279 p., 5⅛ × 8⅛ in., bound. $6. A discussion, illustrated by case histories, of methods for providing adequate stock for production departments while at the same time keeping costs down. The main subjects dealt with include standardization; part numbering and naming; marking; records; storesroom layout; materials handling; receiving, storage, and issuance; protecting stores; and inventory. Classification in part numbering and color codes are briefly treated.

Practical Construction of Warships. By R. N. Newton. Second edition, 1955, Longmans, Green and Company, Inc., New York, N. Y. 464 p., 6¼ × 10 in., bound. $9.50. The new edition of this book has been divided into four sections dealing with the structural work of surface ships, fitting out, materials and installations, and special types of ships. In the revision of the book, certain chapters, such as those on welding and ventilation, have been rewritten, and some new chapters, including one on submarines, have been included.

Proceedings of the RETMA Symposium on Automation. (University of Pennsylvania, September, 1955). Sponsored by the Engineering Department of the Radio-Electronics-Television Manufacturers Association. 1956, Engineering Publishers, New York, N. Y. 114 p., 8⅜ × 10⅞ in., paper. $5. The papers in these proceedings deal chiefly with automation for high-volume assembly and low-volume production, data processing and utilization, and redesign for automatic production. Some of the specific subjects discussed are automatic production of electronic assemblies, automatic warehousing, factory automation by digital control, and production of electronic circuits by mechanized wiring. The proceedings of the RETMA Symposium also include a panel discussion on the future of automation.

Process Engineering Economics. By Herbert E. Schweyer. 1955, McGraw-Hill Book Company, Inc., New York, N. Y. 409 p., 6 × 9¼ in., bound. $7.50. In this book, basic principles of economics and elementary accounting techniques are presented and illustrated by applying them to problems of the various types encountered by engineers in the metallurgical, petroleum, ceramics, and other industries. The first five chapters cover the value of money, amortization, capital requirements, costs, and so on. Later chapters deal with the selection of alternative equipment and processes, replacement of existing equipment, and the economic analysis of specific operations. The analysis of a complete process is dealt with in the last chapter.

Standards and Dimensions for Taps and Dies. Published by the Tap and Die Division of the Metal Cutting Tool Institute, New York, N. Y., 1955. 80 p., 8½ × 11 in., paper. $1.25. This publication contains a brief description of the British and American unified screw-thread standard and a detailed presentation of the 1955 revision of tap standards with accompanying conversion tables and tables of tap recommendations for 2, 3, 2B, and 3B classes of threads. It also contains the complete commercial standards as adopted by the Tap and Die Division of the Metal Cutting Tool Institute.

Steels for the User. By R. T. Rolfe. Third edition, 1956, Philosophical Library, Inc., New York, N. Y. 399 p., 5½ × 8¾ in., bound. $10. This book for the engineering metallurgist deals primarily with carbon steels. Composition, heat-treatment, case hardening, mechanical testing, and the selection of steels are discussed, and special chapters are included on the use of steels at elevated temperatures as well as on weld testing.

Technique et Utilisation des Jauges de Contrainte. By U. Zelbstein. 1956, Dunod, Paris, France. 255 p., 5⅜ × 8¾ in., bound. 1880 F fr. This small treatise on strain gages gives detailed coverage of both the research and practical aspects: Physical and electrical characteristics; methods of operation; methods of application; various types of equipment; and specific examples of use.

Titanium. By A. D. McQuillan and M. K. McQuillan. 1956, Academic Press, Inc., New York, N. Y. 466 p., 5½ × 8⅛ in., bound. $10. The fourth volume in the series "Metallurgy of the Rarer Metals." Recovery, purification, melting, casting, fabrication, and joining are dealt with, as well as physical and mechanical properties, constitution of alloys, corrosion, and metallographic techniques. Also covered are deformation mechanisms and textures, transformations, the reaction of titanium with gases, and the heat-treatment of titanium-rich alloys. References are given after each chapter.

ASME Boiler and Pressure Vessel Code

Interpretations

The Boiler and Pressure Vessel Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N.Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for

action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting March 9, 1956, and approved by the Board on April 26, 1956.)

Case No. 1177-2 (Reopened)

(Special Ruling)

Add the following note to the Reply to read:

Note: In considering the acceptability of joints under Par. U-2(c) in combination with Pars. UG-22 and UG-23, it is not the intent that the combination of direct and localized and secondary bending stress need be held to the Code tabulated allowable stress, although the direct (membrane) stress must be held to the tabulated maximum allowable stress value. The Committee recognizes that such localized stresses primarily influence fatigue performance and it is intended that the manufacturer and inspector will exercise reasonable judgment in assessing a joint for an individual application. Footnote 2 to Par. UG-23(b) recognizes that high localized and secondary bending stresses may exist in Code vessels and the stresses inherent in accepted details can be of assistance as a guide.

The Committee recognizes that more concrete guidance as to allowable stress levels is desirable and the Subcommittee on Unfired Pressure Vessels has a task group assigned to develop more effective rules for expansion joints.

Case No. 1211-1 (Reopened)

(Special Ruling)

Inquiry: May cast nodular iron, which meets the requirements of SA-278 Class 60 cast iron in all respects except for the carbon content equivalent, be used for pressure parts for containing all except lethal substances at pressures not exceeding 300 psi at temperatures permitted in Part UCI of Section VIII and for pressure parts within the limitations of Par. P-12 of Section I?

Reply: It is the opinion of the Committee that cast nodular iron meeting the requirements of SA-278 Class 60 cast iron except for the carbon content equivalent may be used for pressure parts for containing all except lethal substances at pressures not exceeding 300 psi at temperatures permitted in Part UCI of Section VIII and for pressure parts within the limitations of Par. P-12 of Section I provided:

(1) The tensile strength is not less than 60,000 psi;

(2) The yield strength is not less than 45,000 psi;

(3) The carbon content equivalent is controlled to provide a minimum elongation in 2 in. of 15 per cent;

(4) All castings are given a ferritizing anneal;

(5) No repairs are made by welding or brazing;

(6) The material is not used at service temperatures below —20 F except for lower temperatures due to seasonal temperature;

(7) All other requirements of Part UCI are met for construction to Section VIII;

(8) Other limitations given in Par. P-245 and P-246 also apply for constructions to Section I.

Case No. 1217

(Special Ruling)

Inquiry: Specification SB-171 for Copper-Alloy Condenser Tube Plates now lists tensile requirements for more than one range of thickness of each of the materials, Leaded Muntz Metal, Naval Brass, Copper-Nickel Alloy (70-30) and Aluminum Bronze, Alloy E. Table UNF-23 of Section VIII, Unfired Pressure Vessels, of the Code, 1952 Edition, shows for each of these alloys specified tensile properties and maximum allowable stress values without regard to thickness of plate.

Furthermore, Aluminum Bronze, Alloy D, is now included in Specification SB-171 and tensile requirements are given for two ranges of thickness. 90-10 Copper-Nickel Alloy is also now included in SB-171 for one range of thickness.

May the Aluminum Bronze, Alloy D, the 90-10 Copper Nickel Alloy and the other named materials in the various ranges of thicknesses be used in unfired pressure vessel construction under the Code, and if so, what allowable design stresses may be used?

Reply: It is the opinion of the Committee that the SB-171 materials mentioned in the inquiry may be used for unfired pressure vessels under the ASME Code. The maximum allowable stresses are given in the accompanying Table 1. Note that, whereas the stresses listed for the lightest range of thickness are the same as listed in Table UNF-23, 1952 Edition, for (Leaded) Muntz Metal, Naval Brass and Aluminum Bronze, Alloy E, the same is not true for the 70-30 Copper-Nickel. Slight changes have been made in the latter case in accordance with recently obtained test data.

Table 1

Material	Thickness, In.	Temper	Specified Minimum Tensile Strength, Psi	Specified Minimum Yield Strength, Psi	Maximum Allowable Stress Values, Psi, in Tension for Metal Temperatures Not Exceeding Deg F— 100	150	200	250	300	350	400	450	500	550	600	650	700
SB-171 Leaded Muntz Metal	2 and under	Annealed	50000	20000	12500	12500	12000	11200	10500	7500	2000						
	Over 2 to 3.5	Annealed	45000	15000	10000	10000	10000	10000	9000	7500	2000						
	" 3.5 to 5	Annealed	40000	12000	8000	8000	8000	8000	8000	7500	2000						
Naval Brass	3 and under	Annealed	50000	20000	12500	12500	12000	11200	10500	7500	2000						
	Over 3 to 5	Annealed	50000	18000	12000	12000	12000	11200	10500	7500	2000						
70-30 Copper-Nickel	2.5 and under	Annealed	50000	20000	12500	12200	11900	11600	11300	11000	10800	10600	10400	10200	10000	9800	9700
	Over 2.5 to 5	Annealed	45000	18000	11200	10800	10500	10200	9900	9700	9500	9400	9300	9200	9100	9000	8900
Aluminum Bronze D	2 and under	Annealed	70000	30000	17500	17500	16800	16000	15500	15000	14500	12000	10000				
	Over 2 to 5	Annealed	65000	28000	16200	16200	15600	15000	14500	14000	13500	12000	10000				
Aluminum Bronze E	2 and under	Annealed	90000	36000	22500	22500	21000	19500	18000	16500	15000	13500	12000	10500	9000	7500	6000
	Over 2 to 3.5	Annealed	85000	33000	21200	21200	19800	18400	17000	15600	14300	12900	11500	10100	8700	7400	6000
	" 3.5 to 5	Annealed	80000	30000	20000	20000	18700	17400	16100	14800	13600	12300	11000	9800	8500	7300	6000
90-10 Copper-Nickel	2.5 and under	Annealed	40000	15000	10000	10000	9800	9500	9300	9000	8700	8300	8000	7000	6000		

Case No. 1218

(Interpretation of Pars. P-331 and UG-77)

Inquiry: Pars. P-331 and UG-77 and Specification SA-20 require that steel plates 1/4 in. thick and over, be identified by die-stamping certain information at the specified locations on the plate. For plates under 1/4 in. in thickness, stenciling is required in place of die-stamping.

Shell plates subject to rapid rates of temperature and/or pressure change and to possible changes in shock-resistance make die-stamping undesirable. May stenciling or other means of identification be substituted for die-stamping of such plates?

Reply: It is the opinion of the Committee that under the conditions specified in the Inquiry the requirements of Pars. P-331 and UG-77 will be met if plates are marked by stenciling the required identification data on the plate in a manner which will allow positive identification upon delivery, and each such marking recorded in a manner that will allow each plate to be positively identified in its position of the finished vessel to the satisfaction of the authorized inspector.

Case No. 1219

(Special Ruling)

Inquiry: In the construction of vessels to be stamped in accordance with Section VIII of the Code, is it permissible to use pipe and tube of aluminum alloy 996A conforming to ASTM Specification B-274-54T?

Reply: It is the opinion of the Committee that pipe and tube of aluminum alloy 996A conforming to ASTM Specification B-274-54T may be used in the construction of vessels under the rules of Section VIII provided:

(1) The temper agrees with one of those listed in Table UNF-23 for this alloy in the form of sheet and plate;

(2) The allowable stress values given in Table UNF-23 for the corresponding temper of sheet and plate are used in the design calculations for the tube. For tube joined or attached by welding, the allowable stress values for the annealed temper must be used;

(3) The material is assigned P-Number 21 as provided in Table QN-11.1 of Section IX, Welding Qualifications;

(4) The requirements of Par. UNF-65 are satisfied for low-temperature operations;

(5) That in the event that this material is to be used for condenser tubing, the requirements of the pressure test, flattening test, and dimensional tolerances of SB-234 are met.

Case No. 1220

(Special Ruling)

Inquiry: Since the specified tensile strength of GS10A-T6 in Specification SB-274 was decreased by adoption of ASTM Specification B-274-55T, what allowable stress values should be used for this alloy?

Reply: It is the opinion of the Committee that the allowable stress values for pipe and tube of alloy GS10A produced in accordance with Specification SB-274 should be as follows:

Maximum Allowable Stress Values for Metal Temperatures Not Exceeding Deg F

Temper	100	150	200	250	300	350	400
T42	4200	4200	4200	4200	4000	3100	2000
T5	5500	5100	4900	4600	4200	3100	2000
T6	7500	7100	6800	6100	4500	3100	2000

NOTE: These stress values are not applicable to welded construction.

Annulment of Cases

The following cases are to be annulled:

CASE NOS.	REASONS FOR ANNULMENT
1064	No longer used.
1130	Trycocks no longer used and nonferrous material is no longer in short supply.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

As NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Material Specifications, 1956

The Boiler and Pressure Vessel Committee has approved adding to Section II the following new specification:

SA-372-55T, Specification for Carbon and Alloy Steel Forgings for Pressure Vessel Shells;

SB-274-54T, Specification for Aluminum and Aluminum-Alloy Pipe and Tube for Pressure Vessel Applications, revise to include alloy 996A.

Power Boilers, 1956

PAR. P-268 (a) (3) (b) Revise the 1954 Addenda to read:

Calculations demonstrating compliance with Par. P-268(c) shall be made for single openings not covered in (3) (a) when the diameter of the opening in the shell or header exceeds that permitted in Fig. P-34.

PAR. P-268(h) (5) Add a new sentence after the first sentence to read:

Smaller sizes of pipe may be threaded into thinner sheets provided the number of threads engaged are the minimums shown.

TABLE P-7 Add the accompanying stress values.

Additional Materials and Stress Values to be Added to Table P-7

Spec. No.	Grade	Nom. Comp.	Spec. Min. Ten.	For Metal Temperatures Not Exceeding Deg F: −20 to 400	500	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200
PIPE & TUBES																		
Seamless Alloy Steel																		
SA-213	T5c	5 Cr-1/2 Mo-Ti	60000	15000	14500	14000	13700	13400	13100	12800	12400	11500	10000	5200	3400	2400	1800	1200
SA-335	P5c	5 Cr-1/2 Mo-Ti	60000	15000	14500	14000	13700	13400	13100	12800	12400	11500	10000	5200	3400	2400	1800	1200

TABLE P-12 Revise to read as follows:

Table P-12 Minimum Number of Threads for Connections

(a) *Pressures up to and including 300 psi*						
Size of pipe connection, in.	1 & 1¼	1½ & 2	2½ to 4	4½ to 6	7 & 8	
Threads engaged	4	5	7	8	10	
Min. plate thickness required, in.	0.348	0.435	0.875	1.0	1.25	
	9 & 10	12				
	12	13				
	1.5	1.625				
(b) *Pressures above 300 psi*						
Size of pipe connection, in.	½ & ¾	1 to 1½	2	2½ & 3	4 to 6	8
Threads engaged	6	7	8	8	10	12
Min. plate thickness required, in.	0.43	0.61	0.70	1.0	1.25	1.5
	10	12				
	13	14				
	1.62	1.75				

Unfired Pressure Vessels, 1956

TABLE UNF-23 Add the accompanying stress values.

Welding Qualifications, 1956

PAR. Q-6(a) (4) Revise to read:

(4) Tensile specimens conforming to the dimensions given in Fig. Q-6(d) may be used for testing pipes or tubes with an outside diameter of 3 in. or less. The tests shall meet the requirements in (c).

FIG. Q-8.1 & QN-8.1 Add the accompanying figure.

PAR. Q-8(b) Revise the last sentence to read: "The specimen shall be forced into the die by applying load on the plunger until the curvature of the specimen is such that a 1/8-in. diameter wire cannot be inserted between the die and the specimen of Fig. Q-8 and so that the specimen is bottom ejected if the alternate roller-type of jig of Fig. Q-8.1 is used."

PAR. Q-8 Delete the last sentence of subparagraph (c). Add as a new subparagraph (d):

(d) In those cases where the wall thickness of the tube or pipe is less than 3/8 in. and the diameter-to-thickness ratio does not permit the preparation of full-size rectangular guided-bend specimens, the 1½-in.-wide standard guided-bend specimen shown in Fig. Q-7.2 may be replaced by three subsize specimens having a width of 3/8 in. or 4t, whichever is less. The weld reinforcement and backing ring shall be removed flush with the pipe or tube surface and the corners may be provided with a radius, not to exceed 1/8t, prior to conducting the bend tests.

PAR. QN-6(a) (4) Revise to read:

(4) Tensile specimens conforming to the dimensions given in Fig. QN-6(d) may be used for testing pipes or tubes with an outside diameter of 3 in. or less. The tests shall meet the requirements in (c).

PAR. QN-8(b) Revise the last sentence to read: "The specimen shall be forced into the die by applying load on the plunger until the curvature of the specimen is such that a 1/8-in. diameter wire cannot be inserted between the die and the specimen of Fig. QN-8 and so that the specimen is bottom ejected if the alternate roller-type jig of Fig. QN-8.1 is used."

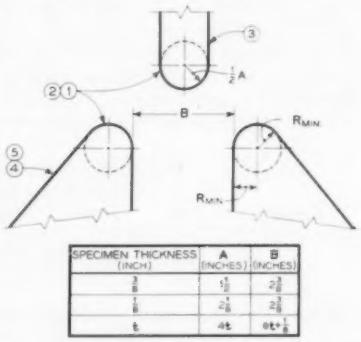
PAR. QN-8 Delete the last sentence of subparagraph (c). Add as a new subparagraph (d):

(d) In those cases where the wall thickness of the tube or pipe is less than 3/8 in. and the diameter-to-thickness ratio does not permit the preparation of full-size rectangular guided-bend specimens, the 1½-in.-wide standard guided-bend specimen shown in Fig. QN-7.2 may be replaced by three subsize specimens having a width of 3/8 in. or 4t, whichever is less. The weld reinforcement and backing ring shall be removed flush with the pipe or tube surface and the corners may be provided with a radius, not to exceed 1/8t, prior to conducting the bend tests.

TABLE QN-24 In the last entry in the fourth column, delete "or 1.5t [4]." Add a footnote reference "4" to the column heading "Max." of the fourth column.

Revise footnote 4 to read:

[4] The maximum thickness qualified in oxyacetylene gas welding is the thickness of the test plate or pipe.



SPECIMEN THICKNESS, t (INCH)	A (INCHES)	B (INCHES)
3/8	1 1/8	2 3/8
1/8	2 1/8	2 3/8
t	4t	4t + 1/8

Figs. Q-8.1 & QN-8.1 Alternative Roller-Equipped Guided-Bend Test Jig for Bottom Ejection of Test Specimen. (R_{min} to be not less then 3/4 in.)

Notes: (1) Either hardened and greased shoulders or hardened rollers free to rotate shall be used.

(2) The shoulders or rollers shall have a minimum bearing surface of 2 in. for placement of the specimen. The rollers shall be high enough above the bottom of the jig so that the specimens will clear the rollers when the ram is in the low position.

(3) The ram shall be fitted with an appropriate base and provision made for attachment to the testing machine, and shall be designed to minimize deflection and misalignment. The ram to be used with the roller jig shall be of identical dimension to the ram shown in Fig. Q-8 and QN-8.

(4) If desired, either the rollers or the roller supports may be made adjustable in the horizontal direction so that specimens of *t* thickness may be tested in the same jig.

(5) The roller supports shall be fitted with an appropriate base designed to safeguard against deflection or misalignment and equipped with means for maintaining the rollers centered, midpoint and aligned with respect to the ram.

(6) The thickness of specimen of 1/8 in. should be used only for materials in Group P-23 and SB-171 Alloy E in Group P-35 in Table QN-11.1.

Additional Material for Table UNF-23

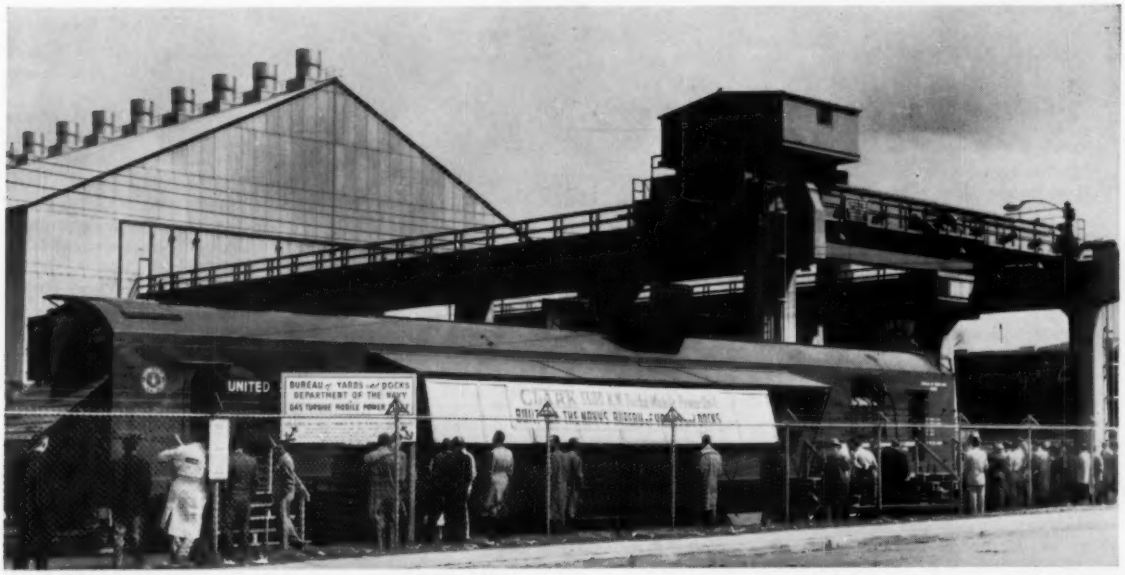
Spec. No.	Alloy	Temper	Specified Tensile Strength, Psi	Minimum Yield Strength, Psi	Notes
PIPE AND TUBE					
SB-274	996A	O	9500	2500	...
		H112	10000	4000	(1) (2)
		H14	12000	10000	(1)

For Metal Temperatures Not Exceeding Deg F						
100	150	200	250	300	350	400
1650	1650	1600	1450	1250	1200	1050
2500	2150	1950	1700	1500	1300	1100
3000	3000	2900	2700	2350	2000	1600

ASME News

With Notes on the Engineering Profession

E. S. Newman, *News Editor*



Turbomobile power plant on exhibition at Naval Gun Factory during recent ASME Gas Turbine Power Conference, Washington, D. C. The unit was built by Clark Brothers, Olean, N. Y., for the Bureau of Yards and Docks of the United States Navy, which, as a compact mobile source of emergency power, will operate continuously and is capable of developing 5500 kw of electrical power, enough to supply a city of 12,000 people. Display was arranged in conjunction with the ASME Gas Turbine Power Division by the Bureau of Yards and Docks.

First ASME Gas Turbine Power Conference and Exhibit Judged Smashing Success

The first annual Gas Turbine Power Conference of The American Society of Mechanical Engineers held at the Hotel Statler, Washington, D. C., April 16–18, 1956, was a smashing success, judging by the enthusiasm and interest displayed by the 747 engineers from the United States and abroad who attended.

This meeting, truly international in character, had a substantial number of registrants from England, Canada, Mexico, Switzerland, France, Italy, Germany, Japan, and Thailand. More than 80 per cent of the U. S. registrants came from areas outside of the District, Maryland, or Virginia, thus far exceeding the best hopes of the GPTD Executive Committee for this first conference.

Technical Program

Seventeen papers were presented on the technical program covering the gamut of gas-turbine applications and design. The six sessions included papers on such varied subjects as combustion, land and marine transportation, aviation regenerators and compressors, nuclear-power applications.

Two important papers were contributed by European authors. K. Leist, professor at the Technical University, Aachen, Germany, discussed an experimental arrangement for the measurement of the pressure distribution on high-speed rotating blade rows. C. Keller, director of research and development, Escher-Wyss, Switzerland, presented his papers dealing with operating experiences and design features of closed-cycle gas turbines.

During the program, replete with the latest data in this field of engineering, a new concept for nuclear power stations was suggested by two Brookhaven National Laboratory scientists, L. D. Stoughton and T. V. Sheehan, in their paper "The Liquid Metal Fuel Reactor Closed-Cycle Gas-Turbine Power Plant." They pointed out that a liquid metal fuel re-

LeRoy F. Deming, *left,* vice-chairman, ASME Washington Section, and Urban Niblo, newly appointed director of governmental operations, Dresser Industries, Inc., pause to chat during the inspection trip to the Naval Gun Factory. Clark Brothers Company, builder of the gas-turbine mobile power plant, is one of the Dresser Industries.

ASME President J. W. Barker, *left,* visits Gas Turbine Power Exhibit with C. E. Wilson, *center,* Hon. Mem. ASME, Secretary of Defense

actor could be combined with a closed-cycle gas-turbine generating system to take advantage of the best features of both systems. The authors of the paper suggested use of a uranium-bismuth solution in the reactor core, with the cycle working gas acting as a coolant and as the heat-transfer medium.

GTP Exhibit

Adding to the world-wide flavor of the conference were exhibits from four foreign countries to round out the 23 exhibits by U. S. manufacturers. The exhibit was run by Barry Freer, an independent operator, under the general supervision of R. Tom Sawyer, member of the GTPD Executive Committee. Exhibitors expressed complete satisfaction with the show and were gratified by the selected audience that attended.

Inspection Trip

One of the high lights of the meeting was a tour of the Naval Gun Factory on Tuesday afternoon, which showed practical applications of gas turbines to helicopters, fire pumps, locomotives, utility application with jet-engine starting, air cooling, mine sweepers, launches, naval landing craft, and rail-mounted mobile generating plants. This outdoor exhibit and demonstration was previewed on Monday morning, April 17, on the Dave Garroway TV show, "Today," with an estimated audience of six-million people throughout the country.

GTP Banquet

J. W. Barker, ASME President, conferred Honorary Membership in the Society on Charles Erwin Wilson, Secretary of Defense, before a large audience attending the banquet held Tuesday night. Principal speaker for this occasion was Clifford C. Furnas, Mem. ASME, Assistant Secretary of Defense for Research and Development, whose address was entitled, "The Big Push." In his talk Dr. Furnas stressed the need for continuing efforts toward improving our aviation facilities both for military and for civilian use.

Women's Program

The program for the women who attended the conference was planned by the Washington Section with much thought for their comfort and pleasure. The beautiful capital city offered an impressive backdrop during cherry-blossom time for the sight-seeing trips to the various art gallerys, to the embassy area, the famous buildings, and shops. The program was topped off with a boat trip down the Potomac River, including a tour of Mt. Vernon, returning by bus through Alexandria, Va., and a visit to old Christ Church.

Future GTP Conferences

The outstanding success of this conference has assured its continuance on an annual basis. The Executive Committee of the Division has approved the scheduling of the second conference for some time during the week of March 17–22, 1957, at the Sheraton-Cadillac Hotel, Detroit, Mich., with plans for an enlarged exhibition.

Charles E. Wilson, *right,* Secretary of Defense, receives Certificate of Honorary Membership in the ASME from J. W. Barker, ASME President

Availability List for 1956 ASME Gas Turbine Power Conference Papers

THE papers in this list are available in separate copy form until Feb. 1, 1957. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	Title and Author
56—GTP-1	Design Considerations for Naval Gas Turbines, by G. L. GRAVES, JR.
56—GTP-2	Development of a Centrifugal Compressor for a Small Gas-Turbine Engine, by N. R. BALLING and V. W. VAN ORNUM
56—GTP-3	Effect of Ambient and Fuel Pressure on Nozzle-Spray Angle, by S. M. DE CORSO and G. A. KEMENY
55—GTP-4	6200-Kw Gas-Turbine-Driven Mobile Power Plant, by Z. STANLEY STYS
56—GTP-5	Gas-Turbine Rotary Regenerator—Design and Development of Prototype Unit for 3000-Hp Plant, by W. E. HAMMOND and T. C. EVANS
56—GTP-5	El Paso's Gas-Turbine Operating Experience, by A. H. CARAMEROS
55—GTP-7	33,000 Hours on Marine Gas Turbine in Naval Service, by W. M. M. FOWDEN, JR., and J. W. SAWYER
56—GTP-8	A New Solar Gas-Turbine-Driven Auxiliary Power Plant, by R. KRESS
56—GTP-9	Rotary Regenerator for Gas Turbines, by J. C. MILES, N. A. PARKER, and R. L. SMOOT
55—GTP-10	Gas Turbine for Mobile Power Unit, by F. O. HENNIG
56—GTP-11	Increased Life for Gas-Turbine Combustion Systems Burning Residual Fuel, by R. W. MACAULAY and C. M. GARDINER
56—GTP-12	The Liquid Metal Fuel Reactor Closed-Cycle Gas-Turbine Power Plant, by L. D. STOUGHTON and T. V. SHEEHAN
56—GTP-13	An Experimental Arrangement for the Measurement of the Pressure Distribution on High-Speed Rotating Blade Rows, by K. LEIST
55—GTP-14	Development of High-Speed Sleeve Bearings for a Solar 500-Hp Gas-Turbine Engine, by D. E. BLACKWOOD and I. M. SWATMAN
56—GTP-16	Internally Fired Semiclosed Cycle Gas-Turbine Plant for Naval Propulsion, by S. H. DE WITT and W. B. BOYUM
56—GTP-17	Development of the Allison Turboprop Engine, by G. E. HOLBROOK

Left to right, Matthew J. Murphy, ASME General Conference chairman and editor of *Factory Management and Maintenance;* Frank F. Bradshaw, president of the Society for Advancement of Management and president of Richardson, Bellows, Henry and Company; Joseph Warren Barker, ASME President and board chairman and president of Research Corporation; and Bruno Moski, SAM General Conference Chairman and director of industrial engineering, Yale & Towne, gathered at the eleventh annual ASME-SAM Management-Engineering Conference before the banquet on April 26 at which Dr. Barker spoke on "The Role of Management in Meeting Technological Manpower Requirements," and Dr. Bradshaw presented the 1956 SAM Gilbreth Award Medal to Herbert F. Goodwin, associate professor of M.I.T.'s School of Industrial Management.

President Eisenhower Congratulates SAM-ASME Sponsoring Organizations, on 11th Annual Management-Engineering Conference

Hotel Statler, New York, N. Y., April 26-27

PRESIDENT Dwight D. Eisenhower extended his warm greetings and congratulations in a telegram on April 26 to the Society for Advancement of Management and the Management Division of The American Society of Mechanical Engineers, joint sponsors of the eleventh annual Management-Engineering Conference held on April 26 to 27 at the Hotel Statler in New York, N. Y. President Eisenhower extended warm greetings to those attending the Conference and continued: "This yearly event focuses attention on the latest management-engineering techniques, which play a role of great significance in the development of American industrial productivity. Wisely guided management engineering can strengthen job security and open fresh opportunities for employment. Increased efficiency can stimulate business activity and help raise the standard of living. I congratulate the sponsoring organizations and wish all of you an informative and successful conference."

Keynoted by the President, the Conference went on to a record-breaking success in every respect. Attracted by the 16 distinguished technical speakers at the Conference, 1239 management executives and engineers were in attendance through the two-day sessions devoted to the latest proved techniques of business and industry. This represented a 20 per cent increase over the attendance at the previous year's affair.

Under the guidance of H. N. Muller, Jr., chairman of the ASME Management Division, and Harold R. Bixler, executive vice-president of the Society for Advancement of Management, and jointly chaired by Matthew J. Murphy, editor of *Factory Management and Maintenance*, for ASME, and Bruno Moski, director of industrial engineering for Yale and Towne, for SAM, the hard-working Conference Committee drawn from both societies had surveyed the entire United States to bring to the Conference the most able speakers on the new techniques of greatest practical interest to management executives and engineers, covering the key topics of operations research, information processing, automation, work measurement, statistical techniques, material handling, maintenance control, and cost reduction.

The culmination of the Conference came at the banquet on April 26 at which Joseph Warren Barker, ASME President, spoke on "The Role of Management in Meeting Technological Manpower Requirements," presenting the tremendous needs of business and industry for many more technically trained personnel in the present and in years to come as many of the recent far-reaching technical developments discussed at the Conference are applied by more and more companies, and suggesting the cooperation of industry and education required to meet these needs. During the same evening, Frank F. Bradshaw, President of the Society for Advancement of Management, and Allan H. Mogensen, chairman of the Society's Gilbreth Award Committee, presented the 1956 SAM Gilbreth Medal Award to Herbert F. Goodwin of M.I.T.'s School of Industrial Management, for the "distinguished service he has rendered to the industrial engineering movement."

Meetings of Other Societies

June 17–20
American Society of Agricultural Engineers, 49th annual meeting, Hotel Roanoke, Roanoke, Va.

June 17–22
American Society for Testing Materials, annual meeting and exhibit, Chalfonte-Haddon Hall, Atlantic City, N. J.

June 17–23
Fifth World Power Conference, Vienna, Austria.

June 18–20
American Society of Heating and Air Conditioning Engineers, semi-annual meeting, Hotel Shoreham, Washington, D. C.

June 18–21
Institute of the Aeronautical Sciences, annual summer meeting, IAS Building, Los Angeles, Calif.

June 18–22
National Association of Power Engineers, 74th annual convention, Hilton Hotel, Fort Worth, Texas.

June 18–24
French Association of Electronic Engineers, Automation meeting and exhibition, Paris, France.

June 23–29
Stanford Research Institute and University of California High Temperature Symposium, Berkeley, Calif.

June 25–29
American Institute of Electrical Engineers, summer and Pacific general meeting, Fairmont Hotel, San Francisco, Calif.

June 25–29
American Society for Engineering Education, annual meeting, Iowa State College, Ames, Iowa.

June 25–30
International Association for Bridge and Structural Engineering, fifth international congress, Lisbon, Portugal.

June 27–July 26
International Electrotechnical Commission (IEC), Munich, Germany.

July 1–8
International Institute of Welding, annual assembly, Madrid, Spain.

July 2–7
Brazilian Society for the Progress of Science, eighth annual meeting, Ouro Preto (Minas Gerais), Brazil.

July 2–7
International conference on Nuclear Reactions, organized by the Netherlands Physical Society under the patronage of the International Union of Pure and Applied Physics, Amsterdam, Netherlands.

(*ASME Coming Events, see page 588*)

ASME Code for Unfired Pressure Vessels to Supplant Joint API-ASME Code

The code used by the American petroleum industry for over 20 years to build and maintain pressurized refining and storage vessels will be discontinued on Dec. 31, 1956. (See page 596 of this issue.) Known to engineers as the "API-ASME Code for Unfired Pressure Vessels for Petroleum Liquids and Gases" it was formulated and published jointly by the American Petroleum Institute and The American Society of Mechanical Engineers.

The move was announced recently with the publication of a joint declaration by the two groups signed by their respective presidents: Joseph W. Barker for the ASME and Frank M. Porter for the API. The announcement noted that one reason for the cancellation is the growth in scope and completeness of the ASME Unfired Pressure Vessel Code which has been expanded in recent years to cover more completely the material in the joint API-ASME publication.

The joint code, first approved in 1934 and revised four times since then, was intended to outline safe practices in the design, construction, inspection, alteration, and repair of vessels used in the petroleum industry to contain liquids or gases under pressure or vacuum. These include storage facilities as well as refinery equipment such as evaporators, bubble towers, and separators.

Many states now require that construction and maintenance of all such equipment conform to provisions of the joint code.

AMERICAN PETROLEUM INSTITUTE
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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Joint Statement

Discontinuance of the API-ASME Code for Unfired Pressure Vessels

Since 1931 the American Petroleum Institute and The American Society of Mechanical Engineers have cooperated in the formulation and publication of the API-ASME Code for Unfired Pressure Vessels, particularly for the petroleum industry. This code came into being because of the imperative need of the petroleum refining industry to have available the most advanced methods in design, constructing and testing pressure vessels. Such methods were not included in the safety codes for pressure vessels then available. This joint venture brought together the advanced view of the refining engineers and the code making experience of the ASME. The resulting document has had wide acceptance and has passed through five revisions, the latest being in 1951.

In recent years the ASME Pressure Vessel Code has been broadened and improved so that it now more completely covers the petroleum industry's pressure vessel needs and in some respects, is more advanced than the API-ASME Code. This is especially true for the rules applying to many materials that are included in the ASME Code but not in the API-ASME Code. Consequently, the API-ASME Code, as a joint publication and interpretation service, will be discontinued as of December 31, 1956.

In announcing this discontinuance, the two bodies express their official appreciation to all those engineers who devoted their time and efforts to the successful operation of the joint code. The ASME in particular is thankful to the petroleum engineers who worked on the joint code and who contributed to the development of the ASME Code. The API is grateful to the ASME for making its code making experience available in the joint venture and for improving the ASME Code to meet the needs of the petroleum industry.

Frank M. Porter — President, API

Joseph W. Barker — President, ASME

Date May 4, 1956

Copy of agreement discontinuing API-ASME Code for Unfired Pressure Vessels for Petroleum Liquids and Gases

ASME Machine Design Conference Discusses Automation

A successful Machine Design Conference was held in Worcester, Mass., at the Bancroft Hotel, April 10 and 11, 1956. Sponsored by the Machine Design Division of The American Society of Mechanical Engineers in co-operation with the Worcester Section, the attendance figure reached a total or more than 200.

The main theme of the conference was automation, with the final session being devoted to "Automation, Where Is It Taking Us?" This session was in the form of a panel headed by John Haydock, editor, *Metal Working*, as chairman, and having as panelists Roger Bolz, editor, *Automation;* C. E. Evanson, president and general manager, T. A. B. Engineers, Inc., Chicago, Ill.; Clifford Fahlstrom, Associated Industries of Massachusetts; and Otis Burbaker, Research Division, United Steel Workers of America.

At the banquet on April 10, ASME President J. W. Barker extended the greetings of the Society, emphasized the role research is playing in this advancing age, and stressed the importance of encouraging young men and women to study the sciences.

Frederick S. Blackall, jr., past-president and Fellow ASME, served as banquet toastmaster. Charles E. Crede, ASME Vice-President, Region I, welcomed the guests on behalf of the Region.

The main banquet speaker was Charles H. Smiley, head of the Department of Astronomy, Brown University. Dr. Smiley gave a most interesting and illuminating talk on "Our Expanding Universe."

Availability List for 1956 ASME Machine Design Conference Papers

The papers in this list are available in separate copy form until Feb. 1, 1957. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	Title and Author
56—MD-2	Automation for Assembly, by R. G. Dexter
56—MD-3	Machine-Tool Automation and Feedback, by R. Ruszczak
56—MD-4	Remote Control Handling Devices for Conducting Research for Development Work Behind Shielding Walls, by Frank Rino, Jr.

ASME Membership

as of April 30, 1956

Honorary Members	71
Fellows	402
Members	14,748
Affiliates	297
Associate Members (33 and over)	4,325
Associate Members (30–32)	6,198
Associate Members (to age of 29)	13,990
Total	40,031

ASME-ASLE Lubrication Conference Preliminary Plans Announced

PRELIMINARY plans for the third jointly sponsored Lubrication Conference of The American Society of Mechanical Engineers and American Society of Lubricating Engineers, to be held Oct. 8–10, 1956, at Chalfonte-Haddon Hall, Atlantic City, N. J., indicate that special attention will be given to problems involved in the lubrication of nuclear-power equipment.

Eight research papers in this rapidly developing field range from studies of fluid metal as lubricants to the effect of radiation on petroleum products.

Another high light of the conference will be a "report-type" session devoted to papers on hydrodynamic lubrication. This type of meeting assumes that the papers will have been read and studied prior to their presentation and consequently only a synopsis of each paper will be given by a report. It is expected that most of the session will be devoted to discussions and the authors' closures.

Other subjects that will be covered include boundary lubrication and lubricants. Approximately 22 research and development papers will be presented during the conference period.

As in previous conferences, there will be no conflicting sessions and those attending will have the opportunity to hear the presentation of all papers. The practice of providing registrants with preprints of the papers to be presented will be continued.

U of P Conference to Study Technical-Literature Readability

A CONFERENCE on Scientific and Technical Writing will be held August 20 to 24 in Philadelphia, Pa., by the University of Pennsylvania's Institute for Co-Operative Research.

Open to scientists, engineers, editors, writers, and administrators, the conference will provide advanced study and experience-sharing in the art of making technical literature readable. The fundamental problems involved in the communication of technical information will be analyzed, and current systems for handling these problems will be evaluated.

W. L. Batt, *left,* vice-president, American Engineering Council ASME Representative, hands a portion of the bound records of AEC to R. H. Phelps, *right,* director, Engineering Societies Library. The presentation was made with the request that they be maintained in the Library as a record of 20 years' achievement of AEC. Attending the ceremony of presentation, held at the Engineers' Club, New York, N. Y., April 27, 1956, *left to right,* are: E. J. Kates, vice-president, Engineers Joint Council; J. M. Garrelts, ASCE Representative; Warner Seely, chairman, AEC Committee on Membership and Representation, ASME Representative; L. J. Fletcher, treasurer AEC, ASAE Representative; F. Malcolm Farmer, chairman, AEC Finance Committee, AIEE Representative; and C. E. Davies, secretary ASME, Recorder. At this meeting means for perpetuating the name of AEC, under the aegis of EJC, were discussed and in closing, Mr. Batt recalled the large amount of effort that had been expended by a great many devoted engineers in the work of the AEC. The meeting made note of the splendid loyal services of L. W. Wallace and Frederick M. Feiker to AEC during the major portion of the life of AEC, with expressions of appreciation.

Harry F. Arader of the University of Pennsylvania, will be conference chairman. He is the University's industrial liaison officer for research and a lecturer in its Moore School of Electrical Engineering. The University's technical facilities will be open for inspection.

Visiting staff members will include: Richard W. Berge, senior publications engineer, Vanguard (Earth Satellite) Project, Glenn L. Martin Company; David B. Hertz, Mem. ASME, associate professor, Department of Industrial Engineering, Columbia University; J. Bennett Hill, director, research and development department, Sun Oil Company; Cedric Lee, chief writer, Remington Rand Univac Division; Harry E. Marschalk, head, Publications Branch, Navy Bureau of Ordnance; H. C. McDaniel, manager, Technical Information Division, Westinghouse Electric Corporation; Gerard Piel, publisher *Scientific American,* and Robert E. Speers, editor, Engineering Department, E. I. du Pont de Nemours & Company, Inc., and member of the executive board of the Association of Technical Writers and Editors.

The University staff members, besides Dr. Arader, will be Homer T. Cox, James J. Flannery, Emerson Harris, Edward C. Linnehan, and Hunter P. McCartney.

Messrs. Cox, Harris, and McCartney are the editors of Projects Big Ben, Sarl, and Wescom, respectively, three of the interdisciplinary research projects in Pennsylvania's Institute for Co-Operative Research. Mr. Flannery is lecturer in cartography at the University and director of the graphics section of Project Big Ben. Dr. Linnehan, a member of the English Department, is a consultant on communication to various business concerns.

Information and applications may be obtained from Dr. Arader, 3400 Walnut St., Philadelphia 4, Pa.

1956 ASME Fall Meeting to Be Held in Denver, Colo. Sept. 10-12

THE Fall Meeting of The American Society of Mechanical Engineers will be held in Denver, Colo., Sept. 10–12, 1956, at the Cosmopolitan Hotel. The tentative program includes 15 technical sessions sponsored by 10 Professional Divisions of the Society. The President's luncheon will be held at noon on Monday, September 10, and the banquet on the evening of Tuesday, September 11. In addition to the technical sessions to be presented, a number of field trips are being planned. These can include the Hydraulic Laboratory of the U. S. Bureau of Reclamation at Denver; the Cryogenic Laboratory of the National Bureau of Standards at Boulder; and industrial facilities according to the indicated interest, and will be scheduled on Wednesday afternoon, September 12.

Denver is a tourist's Mecca to lovers of mountain scenery, and many visitors, who return again and again, consider the early fall months the best time of the year to visit this region. Sight-seeing trips are available to some of the Denver Mountain Parks including the high-

In the photos, *left,* one sees a view of Long's Peak from Bear Lake; *right,* shows Hallett Peak and Dream Lake, Colo. These magnificent sights and many more will be seen in Colorado during the 1956 ASME Fall Meeting to be held at the Cosmopolitan Hotel, Denver, September 10–12. Inspection trips to various industrial operations also are planned.

way to the summit of Mt. Evans; to Colorado Springs with its famous Broadmoor Hotel, and the nearby majestic Pikes Peak region; and to the Rocky Mountain National Park, which contains some of the most spectacular mountain scenery of the United States. Present plans anticipate short sight-seeing trips on Sunday afternoon, September 9, for those who may arrive early, as well as on Wednesday afternoon, September 12.

A women's program is being planned to include a luncheon and a special sight-seeing tour of Denver. A chartered flight over the foothills area via Western Air Lines is also in the making. This will include such points of interest as the new Air Academy site, the Royal Gorge, the old mining town of Leadville, Grand Lake, and other points of indescribable beauty. The women will be welcome guests at the meeting banquet and luncheons.

1956 Heat Transfer and Fluid Mechanics Institute, Stanford University, June 21-23

The ninth annual Heat Transfer and Fluid Mechanics Institute will be held at Stanford University, Stanford, Calif., on June 21–23, 1956. The American Society of Mechanical Engineers is a cosponsor of the Institute and many of the papers will be published ultimately in the Transactions of the ASME or the *Journal of Applied Mechanics*.

Objectives of Institute

The Heat Transfer and Fluid Mechanics Institute will, this year, continue its established purpose of presenting technical and scientific advances in fluid mechanics, heat transfer, and related fields. Emphasis is given to original work covering more than one specific field of engineering. For example, papers are often presented which are of interest to workers in all of aeronautical, chemical, and mechanical engineering including many of the smaller branches of each of these professions. The primary objective of the Institute is to provide a common meeting ground for workers with a research interest in heat transfer and fluid mechanics. The Institute thus provides a means for the most effective interchange of ideas by direct discussion, and hence stimulates and aids the intellectual and professional growth of the engineering community.

Originally organized to serve the Western Community, the Institute, from its inception, has been so successful as a common meeting ground for professional men with a strong interest in research that it has always been national in scope, and in recent years, international as well. Conventionally, contributors and attendants come from all over the United States in addition to foreign countries.

Panel Discussions

This year, in addition to the usual papers covering advances in the specific fields of heat transfer and fluid mechanics, the Institute has scheduled two sessions on irreversible thermodynamics. The purpose of these meetings is to explore the questions: "What applications has irreversible thermodynamics in the solution of problems of heat transfer and fluid mechanics? Can unsolved problems in the older fields of fluid mechanics and heat transfer be handled by the newer theory of irreversible thermodynamics? In what directions is effort needed to make the theory of irreversible thermodynamics a useful tool for the research and the design engineer?" Particular attention will be given to the variational theorems and methods in discussing these questions.

Two sessions on irreversible thermodynamics have been scheduled. The first, on Saturday morning, June 23, will include the presentation of three papers by men who have made signal contributions to irreversible thermodynamics in the original theory and in engineering applications. The second session, on the afternoon of the same day, will be a panel discussion followed by an open discussion of the questions set forth in the foregoing. The purpose of these discussions is to allow for full interchange of ideas and problems between the chemists, applied mathematicians, and the various types of research engineers represented.

It is hoped that this interchange of ideas will lead to the development of new theoretical methods and new means for calculation as well as the further clarification and utilization of already existing theory.

Proceedings

Copies of presented papers will be distributed to Institute attendees. A limited number of proceedings may be obtained after the Institute by ordering from Stanford University Press, Stanford, Calif. Copies of the 1951, 1953, and 1955 papers are available and can be ordered from the Stanford University Press at the following prices: 1951, $5; 1953, $5.50; and 1955, $5.50.

Institute Program

The complete program is given as follows:

THURSDAY, JUNE 21

8:30 a.m.

Registration

9:00 a.m.

Session (I)

Introduction: *S. J. Kline,* general chairman
Dedication to *A. P. Colburn,* 1904–1955, and *Max Jakob,* 1879–1955

Ebullition From Solid Surfaces in the Absence of a Pre-Existing Gaseous Phase, by *S. G. Bankoff,* Rose Polytechnic Institute

Effect of an Ultrasonic Field on Boiling Heat Transfer—Exploratory Investigation, by *S. E. Isakoff,* E. I. du Pont de Nemours and Co., Inc.

Solving the Melting Problem Using the Electric Analogy to Heat Conduction, by *D. R. Otis*, Oak Ridge National Laboratory

2:00 p.m.

Session (II)

Effect of Axial-Fluid Conduction on Heat Transfer in the Entrance Regions of Parallel Plates and Tubes, by *P. J. Schneider*, University of Minnesota

Heat Transfer in a Pipe With Turbulent Flow and Arbitrary Wall-Temperature Distribution, by *C. A. Sleicher, Jr.*, Shell Development Co., and *Myron Tribus*, University of California, Los Angeles

Heat Transfer of a Laminar Pipe Flow With Coolant Injection, by *S. W. Yuan* and *A. B. Finkelstein*, Polytechnic Institute of Brooklyn

Heat Transfer by Forced Convection From a Horizontal Flat Plate Into a Turbulent Boundary Layer, by *A. C. Spengos* and *J. E. Cermak*, Colorado A&M College

FRIDAY, JUNE 22

9:15 a.m.

Session (III)

On the Changing-Size Spectrum of Particle Clouds Undergoing Evaporation, Combustion, or Acceleration, by *A. H. Shapiro* and *A. J. Erickson*, Massachusetts Institute of Technology

Experimental Study of the Velocity and Temperature Distribution in a High-Velocity Vortex-Type Flow, by *J. P. Harnett* and *E. R. G. Eckert*, University of Minnesota

Natural-Convection Heat Transfer From a Horizontal Cylinder Rotating in Air, by *David Dropkin*, Cornell University, and *Arieh Carmi*, Corning Glass Works

2:00 p.m.

Session (IV)

An Analog Solution of the Navier-Stokes Equation for the Case of Flow Past a Flat Plate at Low Reynolds Numbers, by *E. Jansen*, University of California, Los Angeles

On the Supersonic Flow of a Viscous Fluid Over a Compression Corner, by *R. L. Chuan*, University of Southern California

Heat Transfer to a Yawed Infinite Cylinder in Compressible Flow, by *Eli Reshotko*, NACA, Lewis Laboratory

The Unsteady Laminar-Boundary Layer on a Flat Plate, by *Sin-I Cheng* and *David Elliott*, Princeton University, Princeton, N. J.

SATURDAY, JUNE 23

9:15 a.m.

Session (V)

Thermodynamics of the First Order, by *Y. S. Touloukian* and *P. S. Lykoudis*, Purdue University

Nonlinear Problems in Thermodynamics of Irreversible Processes, by *I. Prigogine*, Faculté des Sciences de l'Université de Bruxelles, Brussels, Belgium

Thermoelasticity and Irreversible Thermodynamics, by *M. A. Biot*, consulting engineer, New York, N. Y.

2:00 p.m.

Session (VI)

Panel discussion and open discussion of the following questions:

What applications has irreversible thermodynamics in heat transfer and fluid mechanics?

Can unsolved problems in heat transfer and fluid mechanics be treated by use of irreversible thermodynamics?

In what direction is effort needed to make the theory of irreversible thermodynamics a useful tool for the research and the design engineer?

Particular emphasis will be given to the variational theorems and methods.

University of California Launches Graduate Program in Nuclear Engineering

A ONE-YEAR master-of-science program in nuclear engineering and a PhD program in nuclear engineering were initiated last fall by the Mechanical Engineering Division at the University of California, Berkeley. Prof. E. Teller, renowned nuclear physicist, launched the program by presenting the first few lectures in the course on reactor physics. The students have come from various points in the nation to study in the program which emphasizes the production of power, although some aspects of process engineering are also presented.

The master-of-science program consists of the following courses: advanced applied mathematics, nuclear reactor physics, elements of heat and mass transfer, power cycles and power-plant systems, nuclear reactor kinetics, automatic control of nuclear reactors, process heat and mass transfer in nuclear engineering, materials in nuclear reactors, design of nuclear-reactor power-plant systems, seminars conducted with experts in various specialities, and nuclear-engineering laboratory.

The entire second semester of the nuclear-engineering laboratory is spent at the Atomic Energy Laboratories at Livermore, working various experiments with the Livermore water-boiler nuclear reactor. Seminars involve topics such as, biological radiation damage, details of existing nuclear reactors and their characteristics, conceptual designs of research reactors, organizational aspects of the AEC, costs of nuclear-reactor systems, engineering problems in reactors now being designed and built, the USSR reactor program, programming nuclear-reactor problems on the automatic computer, functioning of the reactor safeguard committee of the AEC, thermonuclear processes, and others. In the design course the students work in teams to design a particular nuclear power plant, with criticisms from physicists and engineers on the staff concerning various technical aspects of the plant, its cost, and safety.

The courses are being kept at an advanced level and as general as possible so that the student will not be limited in his concept with regard to the nuclear reactor and it system.

For those students continuing toward a PhD degree in the field of nuclear engineering, courses are available in a variety of subjects, depending upon the student's interest, such as advanced heat transfer, advanced fluid dynamics, theory of elasticity, nuclear physics and chemistry, metallurgy, ceramic engineering, solid-state physics, advanced mathematics, particle accelerators, chemical separations, advanced thermodynamics, automatic control, waste disposal, and so on.

Completion of a curriculum in engineering or physics constitutes the normal prerequisite for the program, with a limitation based on content of curriculum finished, and grades.

Further information may be obtained by writing to the Dean of Engineering, University of California, Berkeley. The deadline on applications for admission is July 15.

E. Teller, renowned nuclear physicist, discusses a problem with professors and students in the graduate program in nuclear engineering which he launched last fall at the University of California, Berkeley

People

Honors and Awards. WALTER R. J. BROWN, research physicist in Kodak Research Laboratories, Rochester, N. Y., has received the Adolph Lomb Medal for 1956 from the Optical Society of America for his scientific contributions to optics.

JOHN VON NEUMANN, noted scientist and member of the U. S. Atomic Energy Commission, is the first recipient of the Enrico Fermi Award. The Award, comprising a medal, a citation, and $50,000, was made in recognition of Dr. von Neumann's outstanding contributions both to the theory and to the design and construction of fast computing machines, indispensable tools of research and development in many phases of atomic energy and its applications. The Award was made to Dr. von Neumann on Thursday, April 26.

MELVIN J. EVANS, Mem. ASME, head of a management engineering consulting firm in Chicago, Ill., was one of the six alumni who were cited for outstanding accomplishments

Herbert Hoover, Jr., Under Secretary of State, received Columbia University's Kemp Medal "for distinguished service in geology" at a testimonial dinner on March 30, 1956, at the Men's Faculty Club, New York, N. Y. An outstanding geophysicist, Mr. Hoover has supervised the exploration for oil and minerals in many parts of the world. He has also invented much equipment widely used in the search for petroleum, and adapted the mass spectrograph, an instrument for weighing atoms, so that it detects the presence of gas, often an indication of oil deposits. In addition to his work as a scientist, Mr. Hoover acted as a special adviser to the State Department in 1953, working out an international consortium made up of one Dutch, one French, and five American oil companies, which solved the difficult Iranian oil situation. The Iranian government saved face and oil production was resumed.

in their fields, at the annual Wisconsin Engineers' Day celebration, University of Wisconsin, College of Engineering, held on the UW campus, May 4.

Charles E. Reed, general manager, silicone products department, General Electric Company, Waterford, N. Y., will deliver the thirtieth Edgar Marburg Lecture, and D. K. Crampton, director of research and development, Chase Brass & Copper Company, Inc., Waterbury, Conn., will present the fifth Gillett Memorial Lecture at the 59th annual meeting of the American Society for Testing Materials at Chalfonte-Haddon Hall, Atlantic City, N. J.

Clarence E. Davies, secretary and Fellow ASME, was presented with an award of Honorary Membership by The Engineering Institute of Canada. The certificate of Honorary Membership was presented at the annual banquet of the Institute in Montreal on May 25.

Charles K. Leith, retired member of the Combined Development Agency, was presented with a citation for "outstanding services." The Combined Development Agency is a joint United Kingdom-United States-Canadian organization established in Washington, D. C., in 1944 to develop the production and to undertake the procurement of uranium and thorium supplies in certain areas. The agency has production contracts with the Belgian Congo, the Union of South Africa, Australia, and Portugal.

Orlan W. Boston, Mem. ASME, professor and chairman, department of production engineering, University of Michigan, received the Gold Medal Award for outstanding service through published literature, technical writings or papers, from the American Society of Tool Engineers at the annual banquet held in connection with the 1956 Tool Show at the Chicago Amphitheatre. On the same occasion, Edward W. Ernst, Mem. ASME, machine-tool specialist for the Major Appliance Division of General Electric, received the Joseph A. Siegel Memorial Award, given for contributions through leadership, voluntary support, or acts of timely benefit to ASTE.

Francis B. Lord, owner of the Lord Machine Company, was awarded the $500 prize, annually donated by the Worcester Pressed Steel Company, Worcester, Mass. Mr. Lord's redesign of a wave-guide flange for TR radar tubes used for low-frequency scanning, may save as much as $74,000 a year for his customers. The presentation was made at a luncheon of the Pressed Metal Institute in Cleveland, Ohio.

Clinton R. Hanna, electromechanical systems expert, inventor, and associate of research, Westinghouse Electric Corporation, East Pittsburgh, Pa., has been awarded the 1955 Lamme Gold Medal by the American Institute of Electrical Engineers.

Felix E. Wormser, Assistant Secretary of the Interior, received the Egleston Medal, the Columbia University Engineering Alumni Association's highest award for "distinguished engineering achievement," at the 1956 Egleston Medal Award Dinner of the Columbia School of Engineering Alumni Association, held at the Waldorf-Astoria Hotel, New York, N. Y.

Robert E. Wilson was the recipient of the 1956 Washington Award for unusual dedication of leadership through science and engineering to the advancement of research, industry, education, and public affairs. The presentation was made at a dinner given by the Washington Award Commission in Chicago, Ill., May 1.

Research. Robert L. Clark has been appointed executive secretary of the National Committee for the Development of Scientists

Aerial view showing construction progress on America's first full-scale atomic-energy electric power plant at Shippingport, Pa. The two smaller cylindrical reactor-plant containers (at top of picture) will house steam boilers where high-temperature, high-pressure water from the nuclear reactor will generate steam. This steam will be fed to a turbine generator (to be erected in the space near the crane). The fuel-handling canal, *upper right,* will be filled with water, and the atomic fuel will be moved through this water to and from the reactor. The reactor-plant containers and the container for auxiliary equipment are made of 1-in. steel plates. They are 50 ft in diam and 100 ft long. The auxiliary container, *center,* is 150 ft long. Westinghouse Electric Corporation is building the nuclear reactor under contract with the Atomic Energy Commission. Duquesne Light Company of Pittsburgh, Pa., is building the turbine-generator portion of the 60,000-kw plant, and will operate the entire plant when it is completed in 1957.

and Engineers by the National Science Foundation. In establishing the Committee, President Eisenhower said: "The NSF will provide staff services for the committee and provide leadership to other departments and agencies in carrying forward activities which will contribute to a solution of the problem."

GEORGE W. HOWARD has been promoted to fill the newly-created position of technical director at the Corps of Engineers' Research and Development Laboratories, Fort Belvoir, Va.

New Officers and Appointments. JAMES P. WISEMAN, president of the Fluor Products Company of Whittier, Calif., has been elected president of the Cooling Tower Institute for 1956.

CHARLES C. PRICE, chairman of the Department of Chemistry at the University of Pennsylvania, and former department head at Notre Dame, was elected chairman of the Federation of American Scientists by the National Council at its annual spring meeting in Washington, D. C.

T. A. CROWE, Mem. ASME, was elected president of The Institution of Mechanical Engineers, (Great Britain). Mr. Crowe's achievements in the field of engineering are outstanding. While engineering director of John Brown & Co., Ltd., Clydebank, Scotland, he was responsible for the design and construction of the machinery for, among others, the liners, *Queen Elizabeth* and *Caronia;* H. M. battleships, *Duke of York* and *Vanguard;* and H. M. aircraft carrier, *Indefatigable.*

Joseph W. Barker, *right,* ASME President, presented a certificate of Honorary Membership in the Society to President Eisenhower, April 23, who became the first United States President to be so recognized while in office. In a ceremony at the White House, Dr. Barker said the honor, highest offered by ASME, was "for acknowledged professional eminence in engineering," and recognized the recipient as "Soldier, statesman, and President; tactful and inspiring leader whose planning and administration contributed greatly to the winning of World War II and to the defense of the free world." The presentation was witnessed by several prominent members of the Society.

Atomic-power reactor sites and development laboratories in the Eastern United States were visited by the Chairmen of the Governmental agencies for atomic energy in the United Kingdom and the United States during the week of May 7. Shown looking over views of the 60,000-kw pressurized water-reactor power plant now being built at Shippingport, Pa., are *left to right:* Louis L. Strauss, chairman of U. S. Atomic Energy Commission; Sir Edwin Plowden, chairman of the United Kingdom Atomic Energy Authority; and Rear Admiral H. G. Rickover, USN, ASME Westinghouse Medallist. They also visited the Argonne National Laboratory at Lamont, Ill., and the Oak Ridge National Laboratory and other facilities at Oak Ridge, Tenn. The visit to the United States installations was arranged within the terms of the U. K.-U. S. Agreement for Co-Operation in peaceful uses of atomic energy.

JOHN J. CHYLE, director of welding research, A. O. Smith Corporation, has been elected president of the American Welding Society for the 1956–1957 fiscal year beginning June 1. The other new officers are: First vice-president, CLARENCE P. SANDER, general superintendent, Vernon Plant, Consolidated Western Steel Division, United States Steel Company; and GUSTAV O. HOGLUND, head of welding section, Alcoa Process Development Laboratory, Aluminum Company of America.

LESTER C. HIGBEE, Mem. ASME, has been re-elected president of the American Congress on Surveying and Mapping. Mr. Higbee, also president of W. & L. E. Gurley, engineering and scientific-instrument manufacturers, Troy, N. Y., will serve the Congress for a second year.

JOHN J. UICKER, Mem. ASME, professor and chairman of the mechanical-engineering department of the University of Detroit, was appointed consultant to the Building Officials Conference of America, Material Approvals Structural Bureau.

GUY BENVENISTE, Mem. ASME, Stanford Research Institute economist, was appointed editor of "The Sun at Work," newsletter of the Association for Applied Solar Energy, Phoenix, Ariz.

EGER V. MURPHREE of Summit, N. J., has been appointed Special Assistant for Guided

Missiles. The appointment was announced by Secretary of Defense Charles E. Wilson. Mr. Murphree will be responsible for direction and co-ordination of research, development, engineering, and production of guided-missile activities in the Department of Defense.

BERTRAM S. TRUETT, Mem. ASME, district sales manager, American Meter Company, accepted reappointment by F. W. BEICHLEY, chairman, San Francisco Section, ASME, as representative to the San Francisco Advisory Committee for the Engineering Societies Personnel Service. He and other representatives from other sections of national engineering societies will counsel, guide, and review ESPS operations to assure satisfactory employment service to western engineers.

MARTENS H. ISENBERG, Fellow ASME, president, Combustion Engineering, Inc., has been elected to membership on the corporation of the Polytechnic Institute of Brooklyn.

VICE ADMIRAL FRANK G. FAHRION, USN, the Navy's senior ordnance engineer, who served as second in command in the historic "Operation Crossroads" nuclear tests and commanded the Naval task groups for that operation, retired from his present post as Commander of the Atlantic Fleet Amphibious Force on May 1.

L. B. Lefevre, vice-chairman, Central Savannah River Area Section, ASME, presents Certificate of Merit for 65 years' service to the Society to J. S. Foster, at a meeting held at Timmerman's Lodge, Augusta, Ga., April 12. While employed by the Link Belt Machinery Company, Chicago, Ill., Mr. Foster met Spencer Miller, a long-time member of ASME, who played an important role in the development of Mr. Foster's engineering career. When Mr. Miller later joined the Lidgerwood Manufacturing Company, New York, N. Y., Mr. Foster followed and served as his assistant. In time this company was launched on a program of cableways manufacture; as the business grew, Mr. Foster grew with it. His work took him to the far corners of the earth. When the Lidgerwood Company moved their offices and works to Wisconsin, he resigned as vice-president and chief engineer and formed a partnership with Charles L. Wachter, as engineering consultant, serving clients in the United States as well as several foreign governments. Two years ago Mr. Foster resigned from all business activity.

ASME Marks G. M. Brill's 65-Year Membership

GEORGE M. BRILL of Poughkeepsie, N. Y., has been commended by the Council of The American Society of Mechanical Engineers for his sixty-five years of distinguished service to the Society and for his achievements as an engineer, Frederick H. Evans, chairman of the Honors and Awards Committee of the Section, announced. Mr. Evans and James R. Muenger, chairman of the Mid-Hudson Section, presented the Council's certificate to Mr. Brill just prior to his 90th birthday, which was celebrated Saturday, March 24, 1956.

Mr. Brill is a Fellow, a former vice-president, and a former member of the Council of the ASME. He became interested in ASME through the efforts of Prof. Robert H. Thurston of Cornell University, who was the first President of the Society. Since then he has shared in its development into one of the world's most influential engineering societies. Today its membership totals some 40,000 engineers; its engineering standards and technical publications are recognized and used throughout the world.

Mr. Brill was born in Poughquag, N. Y. He studied at Wesleyan Academy, Wilbraham, Mass., and at Cornell University, from which he earned degrees of Mechanical Engineer (1891) and Master of Mechanical Engineering (1905). He is a member of the honorary scientific fraternity Sigma Xi, the American Institute of Electrical Engineers, and the American Geographical Society. He has conducted engineering research at Syracuse; been chief engineer of the Solvay Process Company, Detroit; was construction and general engineer for all plants of Swift & Company; and has practiced construction engineering in Chicago, Ill., and New York, N. Y. He has been president and director of The Empire Knife Company, Winsted, Conn. and of the Williams Tool Company, Erie, Pa. He has served as chairman of the Chicago Engineering Board for Smoke Suppression and as chairman of the Jury of Awards for the Panama-Pacific Exposition, San Francisco, Calif., 1915. He has contributed technical papers to several engineering-society publications.

During World War I, Mr. Brill held a commission of Major in the United States Army and served as Chief of the Requirements Section and as a consulting engineer to the European Field Command.

Grant H. Voaden presents 65-year ASME Membership Certificate to Gordon Campbell at his home in York, Pa. Mr. Campbell became a Junior Member of the Society in 1891. In 1924 he retired, after having been for 14 years president of York Railways and affiliated companies, Edison Electric Light and Power Company, and York Steam Heating Company. His colleagues credit his vision and foresight for forestalling financial difficulties that would eventually have been encountered in the operation of trolley cars as a result of the growing use of automobiles. Under his management the facilities of the Edison Company were improved, the distribution lines extended, and the generating capacity at the Water Street Station increased. Later, it was the sale of this company which permitted liquidation of the group of companies on the right side of the ledger.

ASME Names J. T. Reid Research Manager

JOHN T. REID, Assoc. Mem. ASME, has been named research manager of The American Society of Mechanical Engineers.

His duties with the Society will include staff service for the Society's various research committees, co-ordination and assistance in fund-raising for research projects, and liaison with the Engineering Foundation and the National Research Council.

Among research activities conducted by ASME are those on fluid meters, properties of steam, lubrication, automatic regulation theory, effect of temperature on the properties of metals, and engineering administration.

From 1951 until he joined the staff of ASME, Mr. Reid was employed by Westinghouse Electric Corporation at its Newark, N. J., plant. While there he established a library of automatic-controls literature in the engineering department of the Meter Division, following which he began the organization and establishment of an automatic-controls laboratory.

He was associated with the Lock Joint Pipe Company of East Orange, N. J., from 1949 to 1951. He participated in the engineering work on Israel's first pipe-manufacturing plant located near Tel Aviv, for Mekroth, an Israeli utility combine. Mr. Reid also re-engineered the plant layout of the firm's Detroit, Mich., plant to increase its capacity both as to the

quantity and sizes of pipe manufactured. In addition, he helped establish an inspection and quality-control group at the company's equipment-manufacturing plant in East Orange.

Mr. Reid has served since 1953 as an educational counselor for the Massachusetts Institute of Technology and acts as liaison between M.I.T. and certain secondary and preparatory schools in the northern New Jersey area.

He holds a BS degree from M.I.T.; an MS degree from the University of Minnesota; and an MBA degree in industrial management from Rutgers University. He has taken additional work at the New York University toward a PhD degree in business administration.

Mr. Reid succeeds F. S. Mallette, Mem. ASME, who will retain the post of executive secretary of the Air-Pollution Controls Committee.

ASME Project Among 27 to Receive Engineering Foundation Grants

A WIDE range of engineering research was advanced with new grants allocated by The Engineering Foundation at its annual meeting held in New York, N. Y., on May 3. Allocations for the 1956-1957 fiscal year total $53,000. They go to 27 projects (including the ASME study of the Properties of Steam) which are receiving estimated outside support of $497,500. The projects are being carried out mainly in university, government, and industrial laboratories all over the country under sponsorship of the major engineering societies.

Projects receiving funds represent all the major branches of the profession and range from a program for predicting disastrous storm surges to a recently instituted three-year research project on the thermal resistivity of soils.

ASME Project

Important to industry is another project receiving one of the grants—a study of the Properties of Steam, which is being sponsored by The American Society of Mechanical Engineers. The Steam Properties Research Program, which was set up at the Fourth International Steam Tables Conference in Philadelphia, Pa., in September, 1954, revives an earlier ASME program that was completed in 1934. Taking into account the extremely high pressures and temperatures in use today in both steam-power generation and chemical processing, the reinstituted program has the ultimate aim of revising and extending the whole field of knowledge of steam properties, including its transport properties. As a first step, it is trying to obtain experimental data for extending the steam-table range to 1500 F and 15,000 psia. The present working steam tables have been in use since 1934.

The steam studies are under way in a number of colleges and at the National Bureau of Standards, where important work is being done in the establishment of new temperature standards and a set of conversion factors between the international temperature scale and the true thermodynamic scale. The entire program is functioning within an international framework.

Engineering Foundation and Research

The Engineering Foundation, which was founded in 1914, administers the income from a $1,500,000 fund dedicated to the stimulation of engineering research. This annual income of some $50,000 has had an importance out of all proportion to its relatively modest size. It has been used judiciously over the years to aid in their early stages many research programs that later were able to obtain large-scale financial backing and develop into important projects.

Gaillard Holds June Seminar in New York and Offers Company-Standards Seminar

THE next Gaillard Seminar on industrial standardization will be held June 18 through 22, 1956, in New York, N. Y. There will be two conferences each day, Monday through Friday, mornings 9:30 to 12:00, afternoons 1:30 to 4:00.

Six conferences will be devoted entirely to organization and procedure of standardization work in an individual company. The other four will deal with the principles and practical applications of organized standardization, both from the technical and the managerial viewpoint. Round-table discussion will present opportunity for the conferees to bring up problems of special interest to their own work.

A new service, the Company Standards Seminar, is offered by John Gaillard, Mem. ASME, following a request from industry. Company managements now may arrange to have his seminar held at their headquarters, with attendance by key men representing various departments, divisions, plants, or other administrative units of the sponsor company. This special Company Standards Seminar will make it possible to have a number of men trained as a group and to concentrate on discussion of the company's particular problems.

Previous Gaillard Seminars in New York have been attended by about three hundred men representing 167 organizations. Of these, 143 are individual companies, and the others trade associations and technical societies; five national standards bodies; the Armed Forces; the National Bureau of Standards; two research organizations; and three colleges.

Further information about registration for the June, 1956, Gaillard Seminar in New York City, or special arrangements for a company-standards seminar, may be obtained from Dr. John Gaillard, 400 West 118 St., New York 27, N. Y. Formerly a member of the staff of the American Standards Association and a lecturer at Columbia University, he now is a management counsel specializing in advice on standardization problems.

How's the Weather?—Ocean-Based Automatic Weather Station Will Tell

A PROTOTYPE marine weather station that automatically reports local weather data by radio has been developed by the National Bureau of Standards. The unit is incorporated in a buoy that can be anchored in remote locations and left unattended for periods up to six months. At regular intervals throughout the day the station broadcasts in code the air temperature, water temperature, barometric pressure, and wind speed and direction. Preliminary tests in Chesapeake Bay show that the station has a radio range in excess of 800 miles. The equipment was developed by P. D. Lowell, W. Hakkarinen, and L. M. Allison of the Bureau's electronic instrumentation laboratory for the Navy Bureau of Aeronautics.

At the present time the gathering of comprehensive weather data from many ocean areas outside of regular shipping lanes is haphazard and limited. Both military and civilian authorities would be better able to predict weather conditions if they received continuous weather reports from a much wider area. If a series of stations similar to the Bureau's prototype station were placed over wide areas of the Pacific Ocean, for example, they could give operations officers and meteorologists frequent reports making possible a complete weather picture for the entire ocean. If moored in certain areas of the Caribbean, these stations might also give warning of hurricanes as they begin to form.

The automatic station translates information from each of five weather-sensing elements into three-letter groups in continental code and transmits the coded signals on a pulse-modulated carrier frequency at about 6 megacycles. These signals can be received on standard communications receivers and compared with a decoding table which gives numerical values for each of the meteorological variables measured. A single transmission takes three minutes. During this interval six items of information are broadcast. The first transmission is a three-letter signal identifying the station. Coded transmissions follow containing information on (1) air temperature between —25 and +110 F, (2) water temperature between 15 and 90 F, (3) barometric pressure between 950 and 1050 millibars, (4) wind speed from 0 to 68 knots, and (5) wind direction oriented from magnetic north.

The vessel which carries the weather-sensing and radio-transmitting equipment was designed by the David Taylor Model Basin and is 20 ft long and 10 ft wide. It is constructed of aluminum and other nonmagnetic alloys to avoid undesirable effects on the compass. The vessel can be anchored in waters as deep as 3600 ft. Two masts and four water-tight wells extending below the boat deck hold all the electronic and meteorological equipment assembled in compact, shock-mounted units. Each unit may be replaced independently of the others.

Coming Meetings

Management of Industrial-Research Programs

A FIVE-DAY conference on the Management of Industrial Research will be held June 11–15, 1956, under the auspices of Columbia University at its Harriman Campus at Harriman, New York. Director of the Conference will be Robert Teviot Livingston, Mem. ASME, professor of industrial and management engineering at Columbia.

The Conference will study methods for the design of research programs from the viewpoint of integrating them with other aspects of company operations. Also to be included are two special panels. The first panel, "Human Relations in Research," is moderated by Lyman Bryson, professor emeritus of education, Teachers College, Columbia University. The second panel, "Operations Research Does a Job on Industrial Research," is moderated by David Bendel Hertz, Mem. ASME, director of Operations Research for Popular Merchandise, Inc.

Principal speakers will include C. C. Furnas, Mem. ASME, Assistant Secretary of Defense for Research and Development; Rear Admiral Rawson Bennett, USN, Chief of Naval Research; T. F. Davies Haines, president, Ciba Pharmaceutical Products, Inc.; Irving Wolff, vice-president in charge of research, RCA Laboratories; and J. J. Healy, assistant to vice-president for research development and engineering, Monsanto Chemical Company.

Conference papers will be available following the Conference in the form of Proceedings to be published by King's Crown Press, Columbia University.

Industrial Engineering

THE annual Cornell University Industrial Engineering Seminars sponsored by the department of industrial and engineering administration, Sibley School of Mechanical Engineering, will be held at the University, Ithaca, N. Y., June 12–15, 1956.

The seminar workshops cover each of the following six areas: Industrial management, manufacturing engineering, small-plant management, methods engineering, applied industrial statistics, and industrial marketing.

Material Handling

THE third annual Material Handling Training Conference will be held at the Lake Placid Club, Essex County, N. Y., June 17–30, 1956. This conference was designed to provide a practical and economical way to develop and to improve existing material-handling programs or to train a handling engineer.

The program of the Conference is divided into three major parts including material-handling equipment, analysis and systems design, and operational problems.

For further information write to J. R. Bright, Director, Material Handling Training Conference, 56 Robbins Road, Lexington, Mass.

Mathematics in Engineering

A CONFERENCE on Mathematics in Engineering will be held June 20–22, 1956, at the University of Michigan, Ann Arbor, Mich., and will be jointly sponsored by the American Society for Engineering Education and the National Science Foundation.

The tentative schedule for the conference includes sessions on probability, statistics, numerical analysis and computers, operations research and systems engineering, continuum mechanics and field theory, and the impact of mathematics on engineering and scientific education.

For reservations or a more detailed program, write Prof. C. M. Thatcher, Department of Chemical and Metallurgical Engineering, University of Michigan, Ann Arbor, Mich.

High-Temperature Symposium

"HIGH Temperature—A Tool for the Future," is the theme chosen for a June 25–27 symposium to be held on the University of California campus at Berkeley. The University and Stanford Research Institute, Menlo Park, Calif., are cosponsoring the three-day meeting.

Discussions will deal with advances in major fields of high-temperature research. Keynote speaker at the June 26 luncheon will be Dr. Theodore von Karman, Mem. ASME, chairman of the Advisory Group for Aeronautical Research and Development, a NATO agency with headquarters in Paris, France. The luncheon will be held at the International House on the Berkeley campus.

The opening-day panels will be devoted to "Methods of Reaching High Temperatures," and will have as cosponsor the Air Office of Scientific Research, U. S. Air Research and Development Command. Speakers will discuss solar, arc, and flame images; electrical heat; and chemical and nuclear processes as sources of temperatures as high as 18,000 F.

The National Science Foundation will cosponsor the second day's program on "Materials for Containing High Temperatures." This meeting will deal with structures and properties of materials for high-temperature use and equilibrium and kinetic considerations involved in their environmental interactions.

The symposium closes on June 27 with the panel on "Processes Occurring at High Temperatures." The Office of Naval Research will be cosponsor for the day. This gathering will discuss such chemical responses under high temperatures as gas state and condensed state reactions, and gas and condensed phase interactions.

Some 36 specialists in these fields will take part in the panels.

Cybernetics

THE Province of Namur is organizing, under the patronage of the Ministry of Education and of UNESCO, and under the honorary presidency of the Governor of the Province of Namur, an International Congress of Cybernetics, which will be held in Namur, Belgium, from June 26 to 29, 1956.

The aim of the Congress is to present for wide consideration the new ideas which are developing under the general term of cybernetics, and to bring into clear relief the realizations already attributable to this new science which, while still at the stage of taking its bearings, is already transforming industry profoundly and is bound to affect all sectors of human activity.

The Congress will be presided over by Prof. Georges R. Boulanger of the Polytechnic Faculty of Mons and of Brussels University. The agenda will be divided into four sections covering both the scientific and technical aspects of cybernetics; namely, principles and methods of cybernetics; semantic machines (computing, translating, and so on); automation (automatic factories); and cybernetics and life.

Persons proposing to attend the Congress are requested to write to the following address: Secrétariat du Congrès International de Cybernétique, 13, rue Basse-Marcelle, Namur, Belgium. More detailed information and application forms will be sent.

ASME Coming Events

June 11–13
ASME Applied Mechanics Western Division Conference, California Institute of Technology, Pasadena, Calif.
(Papers being accepted until program is filled)

June 14–16
ASME Applied Mechanics Division Conference, University of Illinois, Urbana, Ill.
(Final date for submitting papers was Feb. 1, 1956)

June 17–21
ASME Semi-Annual Meeting, Hotel Statler, Cleveland, Ohio
(Final date for submitting papers was Feb. 1, 1956)

June 19–22
ASME Boiler and Pressure Vessel Committee Out-of-Town Meeting held jointly with the National Board of Boiler and Pressure Vessel Inspectors, Windsor Hotel, Montreal, Que., Can.

Sept. 10–12
ASME Fall Meeting, Cosmopolitan Hotel, Denver, Colo.
(Final date for submitting papers was May 1, 1956)

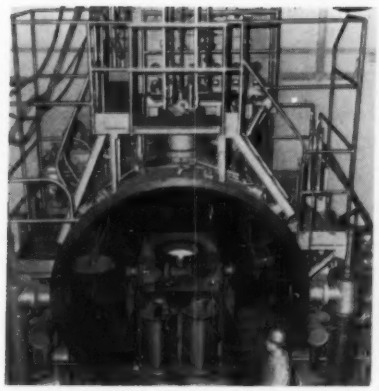
Sept. 17–21
ASME Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Coliseum, New York, N. Y.
(Final date for submitting papers was May 1, 1956)

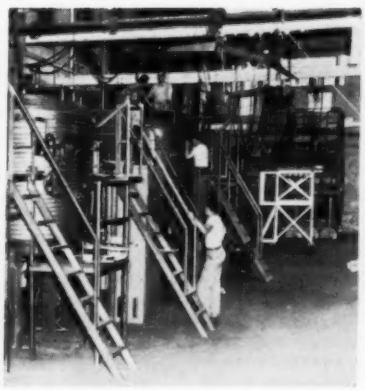
Sept. 23–26
ASME Petroleum-Mechanical Engineering Conference, Conrad Hilton Hotel, Dallas, Texas
(Final date for submitting papers was May 1, 1956)

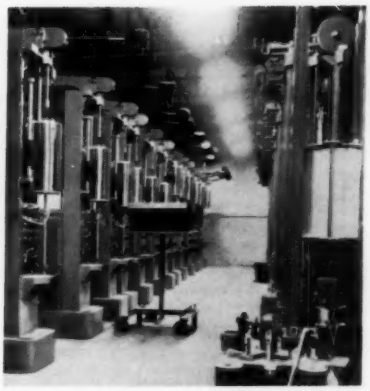
Oct. 8–10
ASME-ASLE Third Lubrication Conference, Chalfonte-Haddon Hall, Atlantic City, N. J.
(Final date for submitting papers was June 1, 1956)

Oct. 24–25
ASME-AIME Joint Fuels Conference, Sheraton Park Hotel, Washington, D. C.
(Final date for submitting papers was June 1, 1956)

Nov. 25–30
ASME Annual Meeting, Hotel Statler, New York N. Y.
(Final date for submitting papers—July 1, 1956)
(For Meetings of Other Societies, see page 579)







From the new color film, "Vacuum Melting," produced for the Metals Division of Utica Drop Forge and Tool Corporation, Utica, N. Y., one sees, *left,* what happened when the technique of vacuum melting was taken "out of the laboratory and into production"; *center,* furnace line today; and, *right,* stress rupture-testing.

Industrial Films

Vacuum Melting

A NEW color film on vacuum melting of alloys is available for distribution from the Metals Division of Utica Drop Forge & Tool Corporation, Utica, N. Y.

The 17-minute film traces the complete process of vacuum melting. Beginning at the conference table where the melt content is discussed, the route is then traced from test melt on to the finished ingot.

Commenting on the film, F. N. Darmara, vice-president and general manager of the Metals Division, said, "Now that we have been able to take the vacuum-melting technique out of the laboratory and successfully adapt it to production-line proportions, we feel that all of us engaged in this activity have an educational responsibility to American industry. The use of the superalloys of vacuum melting have already added much to the development of the jet-aviation industry. We believe that there are other industries where vacuum-melted alloys can make sizable contributions.

"The production of this film is the start of an educational program that we will develop to make industrialists and manufacturers aware of what vacuum melting will do and what is to be gained from it," Dr. Darmara concluded.

Forging and Casting

"THE Shape of Things," a new full-color and sound movie on the forging and casting plant of Allegheny Ludlum Steel Corporation, has just been released for showing.

The movie is in 16 mm and is 16 minutes long. It depicts the forging and casting of tools and end products made by Allegheny Ludlum's plant in Ferndale, Mich.

While the movie was designed for those who are interested in knowing more about the facilities and operations of the forging and casting plant, there is also a great deal of technical information.

Such items as forging techniques, special anvil-die work, the making of composite die sections, and general and special foundry practices are all covered in the film.

This motion picture brings the total number of movies to more than 20 in the film library of the company. All company movies are listed in a booklet G-3, available upon request.

Copies of "The Shape of Things," or any movie in the company library, are available for showing to organized groups on request to the Advertising Department, 2020 Oliver Building, Pittsburgh 22, Pa.

Work Simplification

A 12-PAGE folder, listing 38 films on the use of work simplification in industry, has been published by the Industrial Management Society.

The folder, titled "Work Simplification on Film," explains the terms by which the 16-mm films are available for rental. These films, produced by leading American companies, all have won awards in the annual Methods Improvement Competition sponsored by the society. Many of the films are in color and sound.

The films are approximately 10 to 15 minutes long in running time and picture "before" and "after" operations of work-simplification projects, in both plant and office operations.

Copies of the brochure are available by writing the Industrial Management Society, 35 East Wacker Drive, Chicago 1, Ill. There is no charge for the booklet.

Early Document Linked With Present Technology

A VIRTUALLY forgotten document, written by a 17-year-old boy who in later years became the first academic head of Rensselaer Polytechnic Institute, has added another link to the chain of events which explain the evolution of today's fabulous technology.

The 32-page document sheds additional light on the career of Amos Eaton. It proves that at the age of 17 he had already formulated simple scientific concepts which he would later use as the basis of the English-speaking world's first civilian engineering educational plan. That plan came into being with the founding of RPI, the oldest of the country's colleges of science and engineering, in 1824.

The document, written at the age of 17, was titled, "Art Without Science or the Art of Surveying—Designed for Farmers' Boys," and sold for 12 cents a copy. It touched heavily upon material contained in a later textbook on engineering which outlined part of the Institute's original educational plan. So heavily, in fact, that Eaton called the early pamphlet the first edition of the later work.

Although listed among Eaton's writings, the early document has been among the missing for many years. It was at first assumed that existing copies were destroyed in the great fires which swept the Institute first in 1862, and again in 1904. Samuel Rezneck, professor of history, and Edward Chapman, librarian, renewed the search for the document some time ago and discovered a copy in the technical archives of the New York Public Library. It is not known how many of the booklets were published, but this copy is believed to be the only one in existence.

Dr. Rezneck says the pamphlet written by the young Eaton stemmed from the background of a new nation with an abundance of land in need of survey. At a later date, Eaton, who among other educational achievements, was the originator of the laboratory method of study, wrote about the book, "This little treatise is not a rival of anything in print. Common sense being in its favor, no influence can check its progress."

Eaton had trouble getting his book published. Eight years elapsed between the time he wrote it and when it appeared in print. A clergyman had it published in 1802, Eaton wrote, "to gratify the ambition of my boyhood."

Dr. Rezneck considers the early Eaton work a valuable addition to a collection of memorabilia he has been making over a period of years

which concerns not only Amos Eaton but Benjamin Franklin Greene, the Institute's third academic head who, about 1855, published the plan of engineering education which proved to be the blueprint for all the nation's colleges of science and engineering.

The original copy remains in the New York Public Library. A photostatic copy has been added to the RPI Library's historic materials collection.

Research

Manpower for Research

THE nation's critical shortage of technical manpower "may be a blessing in disguise."

"It could be, if it forces industry, the government, and the independent research organizations to take a critical look at the efficiency of their research operations."

This opinion was expressed by Haldon A. Leedy, director of Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill.

Speaking before some 500 industrial executives attending the first annual National Industrial Research Conference at the Hotel Sherman, April 18, Dr. Leedy said:

"There is no question that the shortage of technical manpower is this country's greatest obstacle to increased research output in the immediate future."

"However," he pointed out, "in spite of this current personnel shortage, I think we can continue to increase our research output by increasing the efficiency of our research programs."

"Actually, we have no choice if the United States is to maintain—and strengthen—its position as a world power," he declared.

Dr. Leedy recommended the following operating methods and techniques which would contribute to an efficient research operation:

1 Acquisition and retention of the best creative scientific personnel available.

2 A well-planned program for the training and professional development of the entire research staff.

3 Selection of the best combination of staff talent to work on each project.

4 Provision of adequate tools for the scientist and engineer in the form of good equipment in order to obtain efficient operation.

5 Availability to the scientist and engineer of various types of nontechnical services so that he can devote his full time to utilizing his own specialized talent.

6 Utmost freedom in the area of scientific thought, but he also must adhere to certain general policies the same as any other member of the organization.

7 Comfortable, well-maintained, but not necessarily expensive laboratories.

Commenting on the 50 per cent increase in productivity during the last 20 years, he said that as a result, "the United States holds a wide margin of leadership in productivity—the key to a better way of life."

To explain why this great increase in productivity has taken place and why the standard of living has been rising so fast, he pointed to the American system of free enterprise and the recent upsurge in the art of good business management as contributing factors.

"But the outstanding reason for our economic growth, and the vital driving force behind our expanding economy," he declared, "is the unprecedented rise of organized research and development."

During the last 20 years, research and development grew from $175 million to $5 billion—a growth of over 1200 per cent when the inflation factor is removed.

One of the best indications of the increased emphasis on research and development in this country, it was pointed out, is the rise of independent, not-for-profit research institutes.

Only two such organizations existed in 1936, he said, performing a combined research volume of $1,100,000. Today, there are 48 such organizations with a total annual volume of about $100 million.

"Increased research effort has enabled companies to avoid obsolescence, to outdistance competition, and, most important, to make greater profits," Dr. Leedy concluded.

Nuclear Science

GOVERNOR MARVIN GRIFFIN of Georgia announced that he is appropriating $300,000 to Georgia Institute of Technology through the Board of Regents to inaugurate a program of education and research in nuclear science.

In addition, he stated that he will ask the 1957 Georgia Legislature to approve construction of an atomic reactor for Georgia Tech "big enough for industrial and commercial research uses." He said that he had been informed that such a reactor will cost "about $3 million."

In making the announcement, Governor Griffin stated: "The growth of the peacetime uses of atomic energy has brought about a great demand for engineers and scientists trained in nuclear science. This technological expansion has also brought about a demand for a broad program of basic research and engineering development in this country. These demands must be satisfied by the nation's engineering institutions which carry out both teaching and research programs.

"In Georgia Tech, the state has the leading engineering education and research agency in the entire South. Studies indicate that Georgia Tech is now ready to greatly expand its activities in the atomic energy field.

"This money is being appropriated to give Georgia Tech the opportunity to carry out the first two phases of a proposed three-phase expansion program. Part of it will be used to set up a program to train student engineers and scientists at the graduate level in the fields of nuclear technology. The remainder will be used to build and equip a radioactive isotopes laboratory. This new laboratory building will house equipment to be used in the graduate laboratory courses, as well as provide facilities for extensive research activities which will benefit industry, agriculture, and medicine in our state.

"The final phase of Tech's proposed program, the acquisition of a research reactor, should be carried out in the near future if the school is to become a major center for nuclear science. The existence of a reactor will mean increased revenue for the area and a strong inducement for certain industrial concerns to locate in Georgia. The reactor would also benefit hospitals, universities, and agriculture interests in the state."

Immediately following the Governor's announcement, Paul Weber, acting president of Georgia Tech, made the following comments:

"Georgia Institute of Technology appreciates the confidence shown in it by Governor Griffin and the Board of Regents in making available the $300,000 to expand the proposed nuclear training and research program. As Governor Griffin pointed out in his statement, this money will enable Georgia Tech to institute an educational program at the master's degree level in the nuclear field, as well as to construct and equip an up-to-date radioisotopes laboratory on the campus."

Aerophysics Research

WILLIAM BOLLAY, president and technical director of the Aerophysics Development

Spectators gathered at Aerophysics' ground-breaking ceremonies and heard talks by William Bollay, president and technical director of Aerophysics, and, *left to right*, Joseph Callahan, acting for the City of Santa Barbara, and Charles Storke, co-editor and publisher of the *Santa Barbara News-Press*. A display of Studebaker-Packard automobiles and Aerophysics' missile equipment can be seen in the background.

Corporation, a subsidiary of the Studebaker-Packard Corporation, turned the first ceremonial spadeful of dirt to officially break ground for Aerophysics' new $1,600,000 research facility being built in Santa Barbara, Calif. The building program is to be completed late this year and will be the permanent facility for the company which is engaged in highly specialized research and development in the field of guided missiles.

On hand at the ceremony were Charles A. Storke, co-editor and publisher of the *Santa Barbara News-Press;* William Hollister, chairman of the Santa Barbara County Board of Supervisors; and Joseph Callahan, representing Mayor John T. Rickard and the City of Santa Barbara. Each of these men in informal talks before the ground was actually broken, noted that the occasion marked the beginning of a new era in Santa Barbara and the Goleta Valley. Among more than 200 spectators at the ceremony were many civic leaders.

Dr. Bollay stated the hope that the new facility would also mark the beginning of a new era for the company. "We can look back on a hundred years of progress on the ground in Studebaker-Packard history," he said, "and we of Aerophysics' hope this event presages 100 years of progress in the air." Dr. Bollay thanked city and county officials who helped facilitate the move.

On display were an early-vintage Conestoga wagon produced by Studebaker, a 1912 Studebaker automobile, 1956 models of Studebaker and Packard automobiles, and a display of Aerophysics' missile equipment and components.

GM Technical Center

Dedication ceremonies of General Motors' new Technical Center on May 16, 1956, were viewed by 20,000 persons on an international closed-circuit television network to 61 cities.

The giant hook-up, extending almost 20,000 miles in the United States and Canada, highlighted the formal dedication program, May 16, at the 330-acre center northeast of Detroit.

Simultaneous meetings were held at the 61 cities where distinguished guests saw the Detroit ceremonies over large-screen television.

Theme of the dedication was "Where Today Meets Tomorrow," in keeping with the Center's role of industrial research. The 25 modern buildings, housing more than 4000 scientists, engineers, stylists, and technicians, make it the largest private-research institution in the world.

The telecast included a TV tour of the Center with Walter Cronkite, noted network newscaster, narrating from his mobile vantage point in Firebird II, GM's latest experimental gas-turbine automobile.

Viewers saw typical experiments being conducted for the benefit of various GM divisions; GM's "free-piston" engine car, XP-500; and exterior and interior views of the Center which won architectural awards even before it was completed.

Following Mr. Cronkite's narrative tour, Harlow H. Curtice, president of General Motors, delivered a major address. Other GM speakers included Lawrence R. Hafstad, vice-president in charge of Research Staff, and Charles F. Kettering, Fellow ASME, inventor and GM research consultant.

The telecast was scheduled for 1½ hours. Technical directors were Theater Network Television, Inc., which handled GM's two previous closed-circuit telecasts. Distribution was by coaxial cable and microwave relay.

The program established a technical first in closed-circuit telecasting. It was the first time for a moving mobile unit to transmit to another mobile unit which in turn was fed to the entire closed-circuit network.

Research at Caltech

Two California Institute of Technology scientists have recently received National Science Foundation grants totaling $26,300 for research in the fields of hydrodynamics and biology, it was announced by President Lee A. DuBridge.

J. Harold Wayland, associate professor of applied mechanics, received a grant of $11,300 for studies of "Streaming Birefringence as a Hydrodynamic Research Tool." The purpose of this work is to determine quantitatively the flow patterns of liquids from a study of their optical properties under polarized light. Dr. Wayland did previous research in this field in 1953–1954 as a John Simon Guggenheim Fellow at the Centre de Recherche sur les Macromolecules in Strasbourg, France.

The second grant, $15,000, was made to Renato Dulbecco, professor of biology, for "Quantitative Study of Animal Virus-Host Complexes."

Dr. Dulbecco's major research has dealt with animal viruses, disease-producing microorganisms that attack men and animals. In 1953 at Caltech, he and research fellow Marguerite M. P. Vogt developed a new technique to simplify virus research by growing a virus on a culture of living cells. The technique was used to isolate for the first time, genetically pure strains of three known types of polio virus.

Education

M.I.T. Summer Courses

The Massachusetts Institute of Technology offers several summer courses covering such important subjects as, Modern Developments in Heat Transfer, Dynamic Measurements, Vibration, Shock, and Noise, and Wear Theory in Metal Cutting and Bearing Design. All will be given June 18–29. From July 9 through July 20 a course will be given on Recent Developments in Fluid Power Control. Fundamentals and Applications of Strain Gage Techniques and Hydrodynamic Stability will be given July 16 through 27. A two-week special summer program in control-systems engineering, designed to integrate the concepts and techniques used in designing control systems, will be given from July 30 through August 10. To review recent advances in the application of mechanical engineering to the textile industry a course on Selected Topics in Textile Technology will be given August 20–31.

Full details and application blanks may be obtained from the Summer Session Office, Room 7–103, Massachusetts Institute of Technology, Cambridge 39, Mass.

Nuclear Reactors and Radiations

The University of Michigan announces a two-week intensive course on nuclear reactors and radiations in industry, to be given in Ann Arbor, Mich., Aug. 20–31, 1956. The course is sponsored by the Nuclear Engineering Committee of the College of Engineering, and will be conducted by members of the Engineering College staff, assisted by guest lecturers.

Lectures covering such topics as elementary nuclear theory, measurements of nuclear radiations, interaction of radiation and matter, and nuclear reactors and fuels, will be coordinated with laboratory demonstrations, tours of University radiation facilities, and examples of industrial applications.

Guest lecturers from industry will present current progress and thinking in the nuclear field. The University of Michigan one-megawatt research reactor, which will be under construction during the course, will be inspected and discussed. Demonstrations using a multikilocurie gamma-radiation source will be conducted. The course is intended for the engineer without previous experience in nuclear technology who wishes to acquire a knowledge of representative problems and techniques in this rapidly developing field.

For further details or for information on application, write Professor William Kerr, Department of Electrical Engineering, University of Michigan, Ann Arbor, Mich.

Rocket Propulsion

A graduate course in rocket propulsion will be offered at the Polytechnic Institute of Brooklyn this fall. Thor P. Torda, Mem. ASME, professor of mechanical engineering and consultant on several Air Force projects, will teach the course.

The new course will cover both liquid and solid propellants, and will include such basic principles as nonsteady aerothermodynamics, combustion kinetics, flame propagation, and detonation. Flame holding and heat transfer through steady and nonsteady boundary layers also will be discussed. Also the elements, design principles, and programming of liquid and solid engines will be given.

The purpose of the course is to present a uniform engineering and scientific approach to the problems encountered in this area of propulsion and to propose methods of solution to yet unsolved problems.

Automation

Part-time education that may help factory workers to adjust to new employment conditions as more automatic machines are used in industry, will be offered at the Industries Training School at Stevens Institute of Technology.

The evening courses are open to high-school graduates who want to learn how to operate, maintain, and service, the complex electric and

electronic devices used in so-called "automatic factories."

Demand for courses on the topic has been spurred by spokesmen for both labor and industry. Companies are becoming alarmed over the shortage of men with the technical education and skill required to operate electronically controlled production systems which are becoming common in industry. At the same time, employees' groups are concerned over the unemployment that may occur as machines replace men in more and more manufacturing processes.

By offering industrial employees an opportunity to train themselves during their spare time, to deal with automatic devices, the school hopes to prepare present workers to deal with the new machines.

The course in industrial control devices is a new addition to a program in electrical technology that has been offered at the nonprofit school for 10 years. Some students are already enrolled in preliminary courses in mathematics and electrical circuits that will enable them to understand the more complex topics covered later in the course. Students with sufficient training or experience are permitted to skip some or all of the introductory subjects.

During the three-year program, students cover such topics as electrical and electronic circuits, electrical machines, and electronic instrumentation. They also may take an optional course in radio and television-systems engineering which traces complete television circuits from studio camera to home receiver.

The announcement noted that some students enrolled at the school are attending on their own initiative, while others are being sponsored by their employers.

The Industries Training School, founded in 1940 as the Defense Industries Training School, is intended to provide trained personnel to work as engineering assistants or production supervisors. It uses the facilities of Stevens Institute of Technology at Fifth and River Streets, in Hoboken, N. J.

Western Electric Scholarships

As part of a new $200,000 program of aid to higher education by the Western Electric Company, Columbia University received two scholarship grants. The Columbia scholarships, to be presented next fall to one student each in Columbia College and the School of Engineering, typify the 125 such scholarships to be made by Western Electric under its new program.

Each of the scholarships presented to Columbia has a maximum value of $800 annually and will be accompanied by an annual grant-in-aid of $600.

Nationwide, the Western Electric Scholarships will be established in 100 engineering schools and 25 liberal arts colleges of 90 private and state educational institutions. Scholarship winners in the colleges need not be pre-engineering students, and the only qualification required of either graduate or undergraduate recipients is that they be citizens of the United States. Actual selection of recipients is left to the institutions, of which only those privately endowed will receive grants-in-aid.

Welding Progress Awards

The James F. Lincoln Arc Welding Foundation of Cleveland, Ohio, is offering $20,000 in cash awards for ideas or suggestions that will accelerate progress in arc welding. Residents of the United States or its possessions are invited to submit ideas to the Foundation on any aspect of arc welding that can be used to advance welded design, welding engineering, or the general application of the arc-welding process. No restrictions are placed on either the nature or the extent of ideas that may be submitted for award. The $20,000 will be distributed in 20 awards with a top award of $5000, others of 4, 3, 2, and 1 thousand dollars and additional smaller awards. Ideas must be submitted by July 30, 1956.

Complete information and rules are available from the James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio.

Literature

Engineering Tables

The completion and publication of "Engineering Tables," the third volume of the ASME Handbook, sponsored by the Metals Engineering Handbook Board of The American Society of Mechanical Engineers, makes accessible to engineers and designers, in a single, 704-page volume, a collection of tables of recognized design standards of the type not found commonly in handbooks; such as, a table of involute functions; methods for finding loads on ball bearings; and information on bars and tubes suitable for reworking into gears, levers, shafts, or screws.

Conveniently arranged in 15 sections with tables which apply to the design of specific parts grouped together, this reference book covers bar stock and shafting; bearings; spur, helical and herringbone, bevel and worm gears; cylindrical fits; keys and keyseating; bolts; springs; aircraft and mechanical tubing; serrations and splines; electrical motors; and gaskets.

In brief, "Engineering Tables" makes design calculations easier and saves the engineer time by placing in his hands design tables needed to supplement his knowledge of standards for shape, dimension, gears, and the like.

Jesse Huckert, who edited the book, is presently with the Jeffrey Manufacturing Company, Columbus, Ohio. Until recently he was professor of mechanical engineering at the Ohio State University. He was formerly the associate editor of *Product Engineering*.

ASME members may purchase a copy of "Engineering Tables" for $12; also available are the other published volumes of the Handbook; namely, "Metals Properties" and "Metals Engineering—Design," priced at $11 and $10, respectively, from the Society at a 20 per cent discount. Orders should be addressed to the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Vertical-Transportation Safety Code

One hundred years ago the first elevator made safe for public use was demonstrated. Since then elevator and escalator applications have increased until now more people ride on them than on all other types of public transportation combined.

Probably the ASME Sectional Committee on a Safety Code for Elevators, who did the prodigious job of formulating and writing the American Standard Safety Code for Elevators, Dumbwaiters, and Escalators, Fifth Edition (1955), did not realize it, but they have produced a fitting tribute to the centennial of vertical transportation that has contributed so much to public convenience, and made possible our modern cities with their skyscraper buildings.

Sponsored by the National Bureau of Standards, American Institute of Architects, and The American Society of Mechanical Engineers, this edition was produced by a 78-member Sectional Committee and 15 subcommittees with a total membership of over 150. Members of these committees included not only those on the Sectional Committee, but others having expert knowledge of the subjects, equipment, and conditions being considered.

Working since 1937, with the exception of the war years, these groups have completely rewritten and enlarged the code and brought it up to date.

It retains the general form and arrangement of the fourth edition, but has been modified to include many new rules and parts. Each rule is given an appropriate title and number to facilitate indexing. Seven new parts cover electric-hydraulic elevators; power and hand sidewalk elevators, private-residence elevators and inclined lifts; inspection and tests of elevators, dumbwaiters, and escalators; alterations, repairs, and replacements; and design data, formulas, and curves. In addition, appendix material has been added which provides data and information useful in the application of the rules. Definitions have been revised and amplified to correspond with the revision of, and additions to, the text.

This edition provides a complete compendium on safe design, construction, installation, operation, inspection, testing, maintenance, alteration and repair of vertical-transportation equipment of all types. It is intended to serve as a standard reference on safety requirements for the guidance of architects, consulting and building engineers, casualty insurance companies, elevator manufacturing, maintenance and repair companies, and as a guide for state and municipal authorities in drafting regulations governing the installation of elevators, dumbwaiters, and escalators. It will also serve as a standard of practice for building owners and managers where equipment included in the scope of the code is used. For these groups this code is a must reference and guide on the safe design, maintenance, and operation of vertical-transportation equipment.

Available by ordering from the ASME Order Department, 29 West 39th Street, New York 18, N. Y., the code is presented in a $5\frac{1}{2} \times 8$ in. volume, with illustrations and tables, 299 pages, in cloth, $4; paper, $3.50.

ASME Codes and Standards Workshop

Reorganization of Sectional Committee B5

Sectional Committee B5, on Small Tools and Machine Tool Elements, and its 25 technical committees constitute one of the largest sectional committee structures sponsored by The American Society of Mechanical Engineers. Recognizing the increasing difficulty in administration of these technical committees, the ASME Standardization Committee and B5 Chairman G. F. Habach, have divided the technical committees into three broad groups, each of which is to be headed by a vice-chairman. The sectional committee chairman and the three vice-chairmen will form a directing group.

G. F. Habach, chairman, Sectional Committee B5

The three vice-chairmen and the technical committees in their respective groups are:

W. H. Seacord, vice-chairman, Group A—Small Tools; with Technical Committees on single-point tools and tool posts; milling cutters; twist drills; punch and die sets; forming tools and holders; jig bushings; rotating air cylinders; taps; reamers; inserted blade milling cutter bodies; knurling; and spindle ends for portable air and electric tools.

F. Steele Blackall, 3rd, vice-chairman, Group B—Machine-Tool Elements; with Technical Committees on spindle noses and collets for machine tools; chucks and chuck jaws; spindle noses and adjustable adaptors for multiple spindle drilling heads; machine pins; mounting dimensions of lubricating and coolant pumps for machine tools; spindle noses for horizontal boring machines; press room standards; and grinding wheel mounts.

L. M. Dalcher, vice-chairman, Group C—Components and Specifications; with Technical Committees on T-slots; machine tapers; designation of working ranges of machine tools; splines and their gages; nomenclature; tool-life tests; markings of grinding wheels; and accuracy of engine and tool-room lathes.

Plans for Revision of Code for Pressure Piping

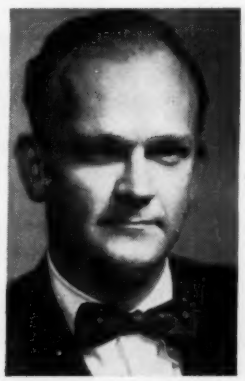
Future revisions of the Code for Pressure Piping (B31.1-1955) will appear in separate publications, not in a combined form, according to a decision recently approved by Sectional Committee B31. The 1955 revision appears in two publications: B31.1-1955, which contains Sections 1–7, and B31.1.8-1955, which contains Section 8.

Revision is now under way to provide seven complete codes, requiring no cross-referencing to other sections, as follows:

1 Power Piping (including District Heating Piping)
2 Industrial Gas and Air Piping
3 Oil Refinery Piping
4 Oil Transmission Piping
5 Refrigeration Piping
6 Chemical Process Piping
7 (Vacant for the interim)
8 Gas Transmission Piping

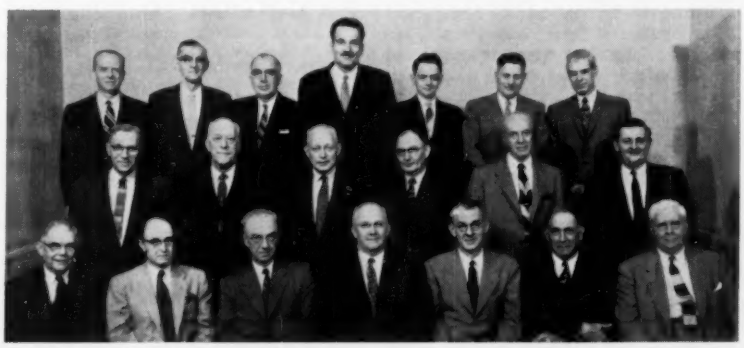
In addition, a uniform outline for all sections has been prepared, so that paragraphs dealing with the same subject have the same number, except for the first digit, which will indicate the number of the section of the Code. A

W. H. Seacord, vice-chairman, B5, Group A



F. Steele Blackall, 3rd, vice-chairman, B5, Group B

L. M. Dalcher, vice-chairman, B5, Group C



At the April 16 meeting of the Executive Committee of B31 Code for Pressure Piping, tribute was paid to valued services of H. R. Redington, *first row, far right,* who had announced his forthcoming retirement from piping-code activities. Present, *left to right,* were: *first row,* D. J. Reid; L. W. Benoit, secretary; Sabin Crocker, vice-chairman; F. S. G. Williams, chairman; E. J. Wiseman; H. A. Clark; Mr. Redington; *second row,* K. W. Haupt; C. A. Kelting; D. C. Carmichael; G. D. Winans; D. B. Rossheim; J. P. Mooney; *third row,* W. M. Frame; W. P. Kliment; G. R. Locke; W. D. Webb; R. V. Warrick; D. J. Bergman; and R. G. Bateman.

decimal system of paragraph numbering has been established for this purpose.

Publication of 1956 ASME Boiler and Pressure Vessel Code

By H. C. Boardman, Chairman, Boiler and Pressure Vessel Committee

As the fruition of over a year's co-ordinated planning and effort, the 1956 Code, complete with all sections, is due for publication on July 1, 1956. There follows a statement of the publication status of each section and a brief description of each section's contents:

Section 1—Power Boilers includes all revisions, deletions, and additions covered by the 1954 and 1955 Addenda. Figs. P-19 and P-20 redrawn for clarification and Tables P-6 and P-7 include all stress values adopted up through January, 1956. Section 2—Material Specifications includes all specifications covered by the 1955 Addenda and 41 revised ferrous specifications, five newly adopted ferrous and 12 revised nonferrous specifications approved by Council of the ASME as of Nov. 15, 1955. Section 4—Low Pressure Heating Boilers contains all revisions and additions covered by the 1955 Addenda. Section 8—Unfired Pressure Vessels contains all revisions, deletions, and additions covered by the 1954, 1955, and supplement to the 1955 Addenda. Eighteen charts for Determining Shell Thickness of Cylindrical and Spherical Vessels Under External Pressure have been indexed and incorporated under Appendix 5 and Tables UCS-23, UNF-23 and UHA-23 include all stress values adopted up through January, 1956. It is the intent of the Boiler and Pressure Vessel Committee that unfired pressure vessels to Section 8 built after Jan. 1, 1957, in accordance with the 1949 and earlier editions should not be marked with the Code symbol. Section 9—Welding Qualifications includes all revisions, deletions, and additions covered by the 1955 Addenda. Recommended forms Q-1 of Procedure Specification and Q-1G and Q-1F of Performance Specification have been revised to meet the requirements of present-day welding practices. Section 3—Boilers of Locomotives, Section 5—Miniature Boilers and Section 7—Suggested Rules for Care of Power Boilers remain unchanged. Case Book (Interpretations) has been completely revised to delete all Cases applicable to the 1949 Edition of Section 8, all Cases wherein the substance has been included in the applicable 1956 Section and all Cases voted for annulment up through March 9, 1956. All new Cases adopted up through March 9, 1956, are included.

New Publications

Ring Joint Gaskets and Grooves (B16.20-1956)—Revision of the previous 1955 standard.

Hexagon Head and Slotted Head Cap and Set Screws (B18.6.2-1956)—Revision of the part of B18.6-1947 covering these screws.

Safety Code for Manlifts (A90.1-1956)—Reaffirmation of the 1949 safety code.

Code for Pressure Piping Interpretations—a collection of all the active case interpretations for B31.1-1955 and B31.1.8-1955, as of Jan. 1, 1956.

Announcement of publication of 1956 ASME Boiler and Pressure Vessel Code was made by H. C. Boardman, chairman, Boiler and Pressure Vessel Committee, at a meeting held recently. Shown at the meeting, *seated left to right,* are: C. W. Wheatley, chairman, subcommittee on Welding; Mr. Boardman, and E. O. Bergman-chairman, Subcommittee on Unfired Pressure Vessels. Standing are J. L. Men, son, chairman, Subcommittee on Materials; *left,* and H. E. Aldrich, chairman, Subcommittee on Power Boilers.

Junior Forum

Conducted for the National Junior Committee

by R. A. Cederberg,[1] Assoc. Mem. ASME

Observations of an Engineer

Dean A. A. Potter[2] made the following remarks of particular interest to younger men in the Society at the Junior Session; a part of the ASME Jubilee Meeting in Chicago, Ill.

As I am getting well started on the second mile of my career and as I compare present conditions with those which existed when I was graduated from college in 1903, may I be pardoned for reminiscence, a privilege of age, while I am reporting certain observations which I hope may prove of interest to you.

Public Attitude Toward Engineering

In discussing public attitude toward our profession with those in other callings, I am told that the engineer lacks a sense of pride in his profession. The role of the engineer who translates science into technology is best exemplified by what has happened in this country since the beginning of this century. In 1900 the automobile, telephone, and the electric light were expensive luxuries enjoyed by the few. We had no airplanes, radios, television, or movies (even silent ones); knew nothing about plastics or synthetic material for clothing; and had not even in our vocabularies the words "electronics," "nucleonics," or "automation." The engineer, by putting science to work, has transferred reliance from animate to inanimate energy, making possible mechanical power and power-driven machinery, and has placed a new valuation upon human life. Can any professional person claim greater contributions to public welfare and human comfort than the engineer? The more than fourfold growth of our profession during the past 50 years has not been paralleled by a full appreciation on the part of the American public of the engineer as a vital part in the life of this nation. This has been a contributing factor to the shortage of engineers.

[1] Westinghouse Electric Corp., Radio-Television Division, Metuchen, N. J.

[2] Dean Emeritus of Engineering, Purdue University, Lafayette, Ind. Hon. Mem. ASME.

Cultural Value of Engineering Education

I am also told that the engineer is apologetic about the cultural value of his education. Aside from preparation for a career, engineering education is a modern form of liberal education, acquainting the learner with the tools, processes, and methods which make our civilization distinctive. Cultured people are those who understand their environment—the world in which they live. Does any form of general education acquaint the student with his surroundings as well as does engineering education?

I am told that engineers are indifferent to public questions. In these days when unrest is too prevalent to be ignored, the greatest need of this, or any democratic government, is men and women in political office who think logically, conclude honestly, and act courageously. The engineer must realize that he is a citizen, as well as an engineer, and that the discharge of his obligations as a citizen is just as important in the long run as his contributions as an engineer. Let us not forget that government is an essential part of our existence, that our usefulness as engineers depends very largely upon the form of government under which we live and work, and finally that the American form of republican government has been most helpful in providing comforts and even luxuries to our people on a scale unheard of in any other country in human history. Let us demand and work for the enhancement of the American way of life through our form of republican government.

Qualities for Success

As a teacher, I have always derived much satisfaction from the successes of my students. As I have appraised the qualities of those of my old students who have reached leadership positions in industry, I have found that, among other factors, they possessed the following qualities:

1 They have enthusiasm for the organization with which they are connected and for its product.
2 They have and show a keen interest in, and respect for, each individual in their organization.
3 They are hard workers and are at all times seeking to improve themselves and their effectiveness.
4 They have emotional stability and the ability to overcome obstacles.
5 They are expeditious; they put first things first; they do not vacillate; and they make decisions promptly.
6 They do not try to do it all themselves, but have the ability to delegate and to shine by reflected glory.
7 They are always ready to assume more responsibility and be accountable for results.
8 They have a sense of humor and an understanding heart.
9 They practice the Golden Rule.
10 They are exemplary citizens.

Engineers With Ideals

The future of our civilization depends upon engineers with ideals; engineers who respect the rights of others and who fully appreciate the meaning of liberty. Thus the education of the engineer is of major concern to the public.

It must be realized, however, that education —no matter how liberal or scientific—does not necessarily make for the best and noblest in human conduct, as evidenced by the sadistic practices of certain well-educated, highly-cultured, and scientifically-competent people who were our enemies in the last war. Knowledge and culture alone do not create happiness and well-being in people who have not cultivated good will and an appreciation of human values. Our only defense against the new tools of destruction is decent people who have no desire to injure or destroy others, and who have the knowledge, vision, and wisdom to turn new scientific knowledge and improved technological devices into agencies to serve and to elevate humanity. To develop high ideals and an appreciation of human values on the part of the engineer, the industrialist, and scientist of tomorrow, our young people in our schools, colleges, and universities must be brought into contact with the best—the best in literature, the best in art, the best in music, the best in social, economic, and political thinking, and most important, with great teachers who appreciate the first-rate in everything; teachers who are creative; teachers who understand the art of living; teachers who have an appreciation of good government; and teachers who have a keen sense of values and a realization of the sanctity of humanity. The future of civilization depends upon scientists, industrialists, and engineers who are not only creative and competent in their field, but who are also civilized, broad, and cultured citizens who feel most and act noblest toward others.

What of the Future?

What of the future? The key to the future industrial supremacy of this country is greater and more economical productivity under a competitive economy. If we produce more at low cost, our standards of living will rise, as we shall be in a position to buy more. More goods at lower prices mean larger sales, and larger sales mean more employment. The greatest need at present is to make the public mind conscious of the dire necessity of creating more wealth by producing more. We have never produced enough to supply our own people. Even in this great country of ours, two-fifths of our homes have no bathroom; three-fifths, no central heating; one-fifth, no electricity; and three-fifths, no telephone. By utilizing fully our abilities to produce, we can elevate the standards of living, not only of Americans, but also of the people of other lands. American industry has plenty of capacity to meet all demands, as it is sufficiently progressive to keep its equipment at maximum effectiveness. The human beings who are the masters of the machines must, however, be willing to do their part, and that is to go to work.

More Science and Engineering

There are some people who are now demanding less science and engineering, and a return to the good old days when our economy was largely on the subsistency level. What is actually needed is more science and more engineering, wisely directed and guided. To maintain our security under present world conditions, we must keep our scientific and our engineering knowledge at a high level, as a basis of national preparedness. Also, more and more science and better and better engineering can open practical frontiers without military opposition, and can make it possible for our country to become self-sufficient with regard to the needs of our people, while elevating the living standards of the people in other lands. We must convince people the world over that scientific and engineering knowledge and skill are cheaper than warfare, and that a nation can obtain abundant life and self-sufficiency much more cheaply and safely by making maximum use of science and technology than through trickery, banditry, and offensive wars.

Actions of the ASME Executive Committee

Meeting at Headquarters, May 4, 1956

A MEETING of the Executive Committee of the Council was held in the rooms of the Society, Friday, May 4, 1956. There were present: Joseph W. Barker, chairman; F. W. Miller, A. C. Pasini, and Louis Polk of the Executive Committee; H. J. Bauer, chairman, Finance Committee; J. L. Kopf, treasurer; E. J. Kates, assistant treasurer; D. W. R. Morgan, past-president; William H. Byrne, vice-president; and Joseph Pope, director; C. E. Davies, secretary; D. C. A. Bosworth and T. A. Marshall, Jr., assistant secretaries.

Committee on Society Income

President Barker reported that the following have been appointed to serve on the Committee on Society Income: D. W. R. Morgan, chairman, J. L. Kopf, F. W. Miller, Louis Polk, and G. B. Warren.

Affiliation of ASME With Other Organizations

The Organization Committee's Subcommittee on Affiliations presented a progress report which was reviewed by the Executive Committee. Further study of the problem is going forward.

Various Operating Years of the Society

At the request of the Council, the Organization Committee reviewed the problem of the various operating years of the Society. The Organization Committee studied the problem and presented a report. The Executive Committee voted to refer the report to the Organization Committee for further consideration.

Appropriation for Welding Research Council

Upon recommendation of the Boiler and Pressure Vessel Committee, concurred in by the Board on Codes and Standards, the Executive Committee voted approval of a contribution of $1000 for the Welding Research Council, to be taken from the A-Development Fund, for support of the work of the Pressure Vessel Research Committee.

1957 Fall Meeting

The Meetings Committee reported that with the approval of the Board on Technology it had scheduled the 1957 Fall Meeting of the Society in Hartford, Conn., Sept. 23–25, Hotel Statler.

Northeast Florida Subsection of Florida Section

Upon recommendation of Vice-President J. B. Jones (Region IV), the Executive Committee of the Council authorized the formation of the Northeast Florida Subsection of the Florida Section, the territory to comprise the following counties: Alachua, Baker, Bradford, Clay, Columbia, Dixie, Duval, Flagler, Franklin, Gadsden, Gilchrist, Hamilton, Jefferson, LaFayette, Leon, Levy, Liberty, Madison, Marion, Nassau, Putnam, Saint Johns, Suwanee, Taylor, Union, and Wakulla.

Northwest Florida Group

Upon recommendation of Vice-President J. B. Jones, it was voted to authorize the formation of the Northwest Florida Group of the Florida Section, the territory to comprise the following counties: Bay, Calhoun, Escambia, Gulf, Homes, Jackson, Okaloosa, Santa Rosa, Walton, and Washington.

Stateline Section

Upon recommendation of Vice-President F. W. Miller (Region III), it was voted to authorize the change of name of the Stateline Section to the Olean Section.

Plainfield Section

Upon recommendation of Vice-President W. H. Byrne, it was voted to authorize the change of name of the Plainfield Section to the Mid-Jersey Section.

Certificates of Award

Upon initiation of their associates and the approval of their respective vice-presidents, Certificates of Award were granted to the following retiring chairmen of Sections: Schenectady, Robert C. Spencer, Jr., and Utah, Julian M. Consley.

Upon recommendation of Vice-President J. B. Jones, the Executive Committee voted to grant Certificates of Award to Alex Brunner and Byron A. Lininger in recognition of their outstanding work in helping to establish the Central Savannah River Area Section.

Honorary Membership for President Eisenhower

The President reported that the ASME Certificate of Honorary Member was presented formally to President Eisenhower in a ceremony at the White House on April 23, 1956. It was conferred "for acknowledged professional eminence in engineering" and recognition of the recipient as "soldier, statesman, and President; tactful and inspiring leader whose planning and administration contributed greatly to the winning of World War II and to the defense of the free world." A small group of officers and members of the Society witnessed the ceremony.

Education Law and Model Law for Registration of Professional Engineers

Mr. Byrne reported that a committee of representatives of the New York State Society of Professional Engineers, the American Institute of Consulting Engineers, the Metropolitan Section of the American Society of Civil Engineers, and others had been formed to study the Education Law of the State of New York. The Metropolitan Section of the ASME had been invited to be represented on this Committee. After discussion, the Executive Committee approved the idea of participation by the Metropolitan Section, with the understanding that any action of that Section's representative cannot commit the Society.

Mr. Pope raised the question as to the desirability of reviewing the Model Law for Registration of Professional Engineers. Those present informally agreed as to the need for this. The Secretary was asked to present this view to James H. Harlow, ASME representative on the ECPD Committee on Recognition.

Industry's Participation in Society Work

Upon the suggestion of President Barker, with the concurrence of the chairman of the Board on Codes and Standards, the Executive Committee of the Council voted to authorize the President to appoint a committee to plan discussions with top management in American industry with a view to securing understanding support for the ASME program on Codes and Standards.

The President also suggested that the time was ripe to replenish the Development Fund, a proposal for which will be forthcoming at the meeting of the Council in Cleveland, Ohio, June 16–17, 1956.

ASME Motion Picture

The Secretary reported as follows on the ASME motion picture: Television, 29 bookings and 9 previews, audience of 2,103,045; Group showings, 159 bookings, audience of 23,840.

ASME Cable Address

At its meeting on April 6, 1956, the Executive Committee released its cable address, "Dynamic" for the use of the General Dynamics Corporation. Suggestions for a new code name were submitted and after discussion, the Executive Committee voted to approve the use of "Mechaneer" as the new ASME cable address.

Use of ASME Emblem

The editors of "Our Wonderful World," a new encyclopedic anthology for children eight to fifteen years of age, requested to use the ASME emblem as an illustration in a section entitled "Careers in Science and Engineering" in Volume XV of the encyclopedia. The request was granted.

Henry Marx' Birthday

The Secretary reported that Henry Marx, a member of the Society since 1880, will celebrate his 98th birthday on June 22, 1956. The President was asked to extend the greetings of the Council to Mr. Marx on that occasion.

New Engineering Societies Building

A communication, dated April 18, 1956, from Barnett F. Dodge, chairman of the Special Task Committee for Engineering Center, stated that it would not be possible for the Task Committee to complete its work and submit a report by May 1, as planned.

Substantial progress is being made but a great deal of factual data has to be sifted and many people interviewed, all of which is time-consuming. It is hoped that the final report of the Task Committee will be forthcoming at least by July 1. E. G. Bailey, ASME representative on the Task Committee, was requested to submit a further report to the Council at its meeting in June.

API-ASME Committee on Unfired Pressure Vessels

Discontinuance of Joint Activity. Since 1931 the American Petroleum Institute and the ASME have co-operated in the formulation and publication of the API-ASME Code for Unfired Pressure Vessels, particularly for the petroleum industry. This joint venture brought together the advanced view of the refining engineers and the code-making experience of the ASME and resulted in a document which has had wide acceptance and which has had five revisions, the latest in 1951.

In recent years the ASME Pressure Vessel Code has been broadened and improved so that it now more completely covers the petroleum industry's pressure-vessel needs and, in some respects, is more advanced than the API-ASME Code. Consequently, upon recommendation of the committee appointed by the presidents of the American Petroleum Institute and the ASME to deal with co-ordination of unfired pressure vessel codes, the Executive Committee voted to discontinue, as of Dec. 31, 1956, the API-ASME Code as a joint publication and interpretation service. (See page 580 of this issue.) (As of Dec. 31, 1956, the Joint API-ASME Committee will be terminated, interpretation will cease, Code Symbol Stamps will not be sold, and the Code will not be sold.)

The Joint Presidential Committee will remain in office in case there is any substantial protest about the decision to discontinue this activity. The Executive Committee expressed its deep appreciation to the Committee for its achievements.

American Standards Association

A communication, dated April 16, 1956, was received from the American Standards Association, proposing amendments in the ASA By-Laws to provide for a revision in the dues structure. It was pointed out that no general increase in dues for member-bodies has been made since 1919, no increase for Associate Members since 1942, and no increase for company members dues since 1940. Subject to approval by the Board on Codes and Standards, the Executive Committee voted to approve the proposed amendments to the ASA By-Laws by revising the dues structure.

Gantt Medal Board of Award

At its meeting on March 2, 1956, the Executive Committee approved a modification in the Gantt Medal Deed of Gift, recommended by the Gantt Medal Board of Award, and in addition suggested another slight modification—the substitution of the word "and" for the words "as a," this section to read: "for distinguished achievement in management *and* service to the community."

This suggestion was not received favorably by the Gantt Medal Board of Award and the Executive Committee was asked to reconsider this. Accordingly, the Executive Committee withdrew its suggested modification in the Gantt Deed of Gift.

Appointments

The Executive Committee noted the following appointments of presidential representatives: Washington Award Dinner, 1956 Recipient, Robert E. Wilson, Chicago, Ill., May 1, 1956, Ben G. Elliott; UPADI Meeting, Mexico, D. F. Mexico, Oct. 8–12, 1956, J. W. Barker, *President*, J. M. Todd, George Browne, S. E. Reimel, C. E. Davies, *Secretary*.

The Executive Committee of the Council approved the following appointments of Society representatives:

World Power Conference, Vienna, Austria, June 16–23, 1956, A. G. Christie; Institute of Aeronautical Sciences, Celebration of Dr. von Karman's 75th birthday, Los Angeles, Calif., June 20, 1956, Floyd Hague; Official representative of ASME to South American Engineering Societies, John C. Burgess.

Engineering Societies Personnel Service, Inc.

THESE items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

Men Available[1]

Mechnical Engineer, 42; 15 years' supervisory experience in product design, new-product development, and product evaluation on consumer items. Desires executive engineering position with smaller company. ME-296.

Executive or Staff Engineer, PhD, MS (IE), PE, law; 12 years' experience in teaching, research, development, design, methods, tooling, production engineering; automation consultant; power plants, hydraulics, mechanical and electromechanical devices. Good administrator. Metropolitan N. J. resident. ME-297.

Sales, Administrative Engineer, young, 25, seven years' experience, five and a half years of sales, in pneumatic conveyers, blowers, cyclone separators, rubber, plastics, advertising. Evening mechanical student, degree in June, 1956. Wants a career in a top company. ME-298.

Executive Engineer, BSME; 60; 13 years consulting engineer for private and public employers on large hydroelectric power-plant design; 16 years' mechanical engineering of hydraulic power machinery. ME-299-48-San Francisco.

Design Engineer, 36, ten years' experience in design of conveyers, materials-handling equipment, and related machinery and structures. Prefers Chicago. ME-300-485-Chicago.

Production Engineer, BSME; 30; cost-reduction engineer, one year on production of telephone equipment, punch press, light machine, and assembly; production-process engineer, four years' processing the assembly and balancing of jet rotors, equipment, Gisholt and Micro Poise Balancers, assembly tooling. Prefers Chicago. ME-301-482-Chicago.

Product Engineer, BSME; 29; five years' experience in product design, machine design, and project work in metalworking field. Prefers Chicago. ME-302-486-Chicago.

Mechanical Engineer, 34; ScD, married; experience in teaching, research, and as consultant to industry in thermodynamics, heat transfer, and turbomachinery; publications in professional journals, proceedings, and transactions. Desires position as associate professor. ME-303.

[1] All men listed hold some form of ASME membership.

Positions Available

Chief Inspector, 35–65, mechanical, experience in power and heating-plant work, to inspect the installation of turbine and heating equipment on a project in Canada. Applicant must be an American citizen and will spend a year out of the country. $8000–$12,000. W-3222.

Inspector or Assistant Professor, preferably with a BS or master's degree in industrial engineering, two to five years' industrial experience. Twelve hours a week teaching, plus opportunity to do outside consulting work. $5200 for academic year. Northern N. J. W-3264.

General Marketing Manager, 45–52, college graduate, engineering and/or marketing major preferred; some experience in personal selling, industrial sales of technical products, and sales management, for company manufacturing metal-cutting tools and allied products. Will be responsible for marketing policy and problems; will conduct merchandising and sales operations, including product planning, market research, pricing, etc. $20,000–$25,000. Western Pa. W-3281.

Material-Production Control Manager, 30–40, engineering degree preferred, for processing and small-parts fabricating. Experience in line production, production control, and material control, preferably in metal fabricating desired. Will coordinate sales and engineering for planning-production and developing-production schedules; assign production to plant and divisions; control material flow and inventories. $10,000–$12,000. Southern New England. W-3282.

Plant Superintendent, 30–40, mechanical graduate preferred, at least five years' experience in tool and diemaking, two to five years' supervisory experience. Must be familiar with all phases of plant maintenance. Some drawing-board background in designing and particularly with relation to blank and form dies necessary. Will supervise maintenance of tools, dies, and equipment; supervise building and plant maintenance. Salary open. Midwest. W-3283.

Chief Engineer, 35–50, to administer an engineering department of 30 people, reporting to vice-president of engineering. Will be responsible for engineering scheduling and costs, product standardization, design, liaison with other major departments. Should have proved record as engineering administrator. Minimum of 12 years' engineering experience including design, test, or development with high-quality product similar to machine tools. Over $10,000. Conn. W-3289.

Industrial Engineer, 44–48, graduate mechanical or industrial, for manufacturer of heavy-industrial equipment. Must be experienced in methods engineering, practical knowledge of very-heavy machining, welding, forming, and fabricating; plant layout, facilities planning, materials handling. Will direct activities of industrial-engineering section in methods studies, plant layout, equipment, and tooling modernization. Plan facilities program for expanding manufacture. $14,000–$18,000, plus benefits. Headquarters, New York, N. Y. W-3291.

Methods Engineer, graduate mechanical or industrial, to develop time studies for machine-tool operations from drawings and time manuals, schedule work through shop. Position with a management consulting firm. Some travel. $7200-$9600. New York, N. Y. W-3294.

Acoustical Engineer, graduate mechanical, considerable experience of noise suppression both from the practical aspect and in theory. Must also have some design experience. To $10,000. Conn. W-3297.

Assistant or Associate Professors, industrial engineering, capable of teaching quality control, plant layout, and materials handling, or wage incentive and production control. Outside income from extension teaching and consulting work. Positions available fall of 1956. $5000–$6000. South. W-3301.

Personnel Director, 35–45, engineering graduate, at least five years' personnel-management experience in drug, cosmetic, or allied process manufacturing fields. $12,000–$14,000. New York, N. Y. W-3310.

Associate Professor, MS degree in industrial engineering, teaching experience to give courses in management, administration, production, and cost analysis at university. Managerial or manu-

facturing experience also desirable. $6000–$7500. East. W-3311.

Consultant, metal-processing development service, in a manufacturing laboratory; 40-50, mechanical degree, at least ten years' experience in light forging, die casting, continuous casting, extrusion, wire processing, or reinforced plastic dies and fixtures. $14,000–$16,000. Eastern N. Y. State. W-3316.

Chief Industrial Engineer, 36–44, college graduate, three to ten years' experience in heavy industry, preferably in all areas of industrial engineering. Should have administrative and supervisory experience. Smelting or furnace operations, industrial-engineering experience required. Will set up and administer an industrial-engineering department for a large reduction-plant operation. Salary open. Northwest U. S. W-3324.

General Manager, 35–45, to participate in and manage development department; ability to handle quality control, costs, and production procedures, for development and manufacturing in the electromechanical field. Salary open. New England. W-3327.

Engineers. (*a*) Research engineers, machine design, mechanical or electrical, a minimum of five years' experience in design, development, or research engineering on semiautomatic or other small machinery. Will analyze basic requirements for equipment in printing industry, and design and develop equipment to fulfill these requirements. $6000–$10,000. (*b*) Project engineer, plant engineering, graduate mechanical or electrical, or equivalent, five years' experience in developing, designing, and installing production machinery; preferably in the paper-production field. $6000–$9000. N. Y. State. W-3330.

Technical Editor, under 40, electrical or mechanical degree, and some design experience. Must be able to write fluently and well, and should show evidence of such ability. Duties include the procurement, selection, writing, and editing of articles and feature departments. Salary open. Ohio. W-3334.

Engineers. (*a*) General manager, 35–45, broad experience with general business administration with emphasis on office (sales and accounting), manufacturing (light assembly and plastic injection molding), and warehousing (shipping and receiving). $10,000–$20,000, plus small bonus and profit sharing. N. J. (*b*) Assembly superintendent, 30–40, industrial engineering, or MBA training and plastic assembly and finishing experience (as in toy manufacturing). Opportunity for promotion to general management status. $7500–$10,000, profit sharing. Calif. (*c*) Molding superintendent, injection plastic, 30–40, thorough understanding of proper supervisory practices as well as molding knowledge. $7500–$10,000. N. J. W-3339.

Engineers. (*a*) Equipment-standards engineer, mechanical or chemical graduate, at least five years' experience in work associated with pumps, motors, starters, fans, agitators, tanks, filters, warehouse equipment, transportation equipment, etc.; to guide program of materials and equipment standardization for large pharmaceutical company. (*b*) Mechanical development engineer, degree, and an interest in devising and experimenting with mechanisms and machines, for a large pharmaceutical manufacturer; to assist in developing specialized manufacturing equipment; to investigate possible applications of the principles of automation to manufacturing and packaging operations. Salary open. Midwest. W-3348D.

Engineers. (*a*) Sales engineer, mechanical graduate, 35–45, experience in customer contact on precision-metal parts and special metal-processing machines. $8000–$10,000. (*b*) Production engineer, to make recommendations for improvements in automatic metal-fabricating machinery, do plant layout, and act as chief trouble shooter in plant. $7800–$8000. N. J. W-3354.

Production Engineering Manager, 35–50, graduate mechanical engineer for company which processes, packages, and distributes a basic and widely used food product. Previous manufacturing and production-engineering experience, five years of which must have included experience in product management in a multiplant operation in a process industry. Will be responsible for the direction and co-ordination of all manufacturing and production engineering at all plants. Opportunity for promotion to vice-president of production. Salary open. Headquarters, southwestern U. S. W-3364.

Research Engineer, mechanical, 35–55, for research, development, and design of light machinery requiring the use of cams and indexing mechanisms. Experience in this field desirable. To $7800. Newark, N. J. W-3365.

Solid Fuels Engineer-Operator, 30–38, degree in mining, civil, or mechanical engineering, ten to 12 years' experience in coal operations. Must have underground experience, some experience in layout plans for exploiting known coal deposits, costs of operating, mine facilities, open pit mining, and operations methods desirable. Should be familiar with latest developments in mining equipment and machinery. Salary open. West Coast. W-3367.

Assistant to Manager of Purchasing, 30–38, degree in business administration or accounting, plus experience in plant purchasing or top administration at plant locations. Experience would be in heavy industry. Will assist manager of purchasing in development and administration of policies, procedures, practices, and personnel, etc. Salary open. West Coast. W-3368.

Mechanical Engineers. (*a*) Project engineers, BS or MS in mechanical engineering, and five to 15 years' experience in process design and plant layout in the field of metallurgy of copper, lead, aluminum, etc. (*b*) Draftsmen, process design and plant layout. Salaries open; fringe benefits. New York, N. Y., or northern N. J. W-3374.

Machine Designer, mechanical-engineering training and at least five years' heavy-machinery or equipment experience for design and development of crushing, grinding, and pulverizing machinery. Company pays placement fee and moving expense allowance. $7000–$8000. Ohio. W-3380.

Product Engineer, BS in mechanical or chemical engineering, three to seven years' experience; to design and develop new products, approve and set up specifications for the product, and maintain a general liaison for manufacturer of pencils and pens. Salary open. Midwest. W-3384.

Automatic Machinery Designer, eight or more years' diversified experience and a specialty, such as plastics production machinery; will be responsible for sales and client relationships, technical guidance, and financial-control projects. To $15,000. Mass. W-3386.

Project Engineer, mechanical or chemical, three or more years' experience in design of process plants or process equipment; to do project work in a pilot plant for distillers of coal tar. Employer will pay placement fee. $8000. Pa. C-4863.

Manager of Industrial Engineering, mechanical or industrial, five or more years' experience, to supervise industrial-engineering department, handling review of product design, manufacturing methods, tooling, equipment and machinery utilization, consulting, plant layout, cost reduction, project tryouts for manufacturer of air conditioning. $12,000–$17,000. Wis. C-4907.

Works Engineer, to 50, at least five or more years' experience in supervising general engineering in heavy industry, to take charge of maintenance engineering, tooling, cost estimating on steel-fabrication work on heavy-sheet metal, with a good deal of heavy-press work, for manufacturer of roof and deck steel. Employer will pay placement fee. $14,000–$15,000. Western Chicago. C-4927.

Chief Production Engineer, mechanical graduate, 35–45, minimum of ten years' experience, five of which should be in design or testing and five years' production engineering. A knowledge of internal-combustion engines. Will act as liaison between manufacturing and engineering, establishing new department. Will handle product modification and improvement after release for production. Occasional travel; no car required. Employer will pay placement fee. $7700–$11,500. Wis. C-4950.

Chief Installation Engineer, graduate, 35–45, eight years' experience, five of which should have been in installation engineering, internal-combustion engineering; and a knowledge of lubrication, cooling, fuel, exhaust-control systems; to act as liaison with customers pertaining to product installation; analyze incoming specifications from sales for items pertaining to installation of prime production including all accessories and systems, and develop accessories and modification of systems. Occasional travel; no car required. Employer will pay placement fee. $7700–$11,400. Wis. C-4951.

Chief Development Engineer, MS, 35–45, five to ten years' experience and at least three years' development work on components of engines. Will be responsible for development of all components of product line and theoretical stress analysis and torsional or linear vibration-analysis systems. Occasional travel. Employer will pay placement fee. $7700–$11,500. Wis. C-4952.

Plant Superintendent, to 45, at least two years' experience in supervising tool and diemaking operations, with a knowledge of blanking and forming die design; to supervise production maintenance of tools, dies, equipment, building, and general plant and safety practices. $11,400. Ind. C-4955.

Plant Superintendent, 35–50, at least five years experience in running a plant, machining own parts, and assembly work; to supervise production, some labor relations, and controlling costs for a manufacturer of feeding machines. Employer will pay placement fee. $9000–$12,000. Northwest Chicago suburb. C-4991.

Chief Tool Engineer, to 50, at least five years' experience supervising cold heading and related secondary operations, to supervise tool engineering and design and to engineer difficult special jobs for production on cold headers. Employer will pay placement fee. To $8500, plus bonus. Chicago. C-4992.

Sales Representative, mechanical graduate or strong mechanical experience, 25–40, with two years' experience selling to any or all of the following: industry, heavy chemistry, petroleum (producing and refining), paper producing, rubber, plastics, and original equipment manufacturers; to call on manufacturers in afore-mentioned industries and work with distributors. Traveling and car required. $6600–$8400. Employer will pay placement fee. Indianapolis or Cincinnati. C-5015.

Candidates for Membership and Transfer in ASME

THE application of each of the candidates listed below is to be voted on after June 25, 1956, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and •Transfers

California

•AUSTIN, JERE J., San Carlos
DRUCKE, ERWIN C., Arcadia
•MITCHELL, EDWARD J., JR., Lompoc
ROLL, DAVID H., San Diego
SMITH, HERBERT L., Gardena

Colorado

MCCLINTOCK, R. MICHAEL, Boulder

•Transfer to Member or Affiliate.

NICHOLLS, GEORGE C., Boulder
VAN GUNDY, DONALD A., Boulder

Connecticut

BIKOVSKY, ALEXANDER G., Bridgeport
FOGGETT, CHARLES M., Norwalk
MAPES, THEODORE J., New Haven
YOUNG, ALLAN M., Meriden

Delaware

•OJALVO, MORRIS S., Newark
•SHIELDS, CARL D., Wilmington
SHILLING, EDWARD W., Wilmington

District of Columbia

HILLHOUSE, ANDREW F., JR., Washington

Florida

CHAPMAN, BOBBY J., Miami
DRICA-MINIERIS, OSWALD A., Pensacola
O'NEAL, ELLIS H., Miami
VAN DE ERVE, MARK R., Panama City

(ASME News continued on page 600)

it's **boiler check-up** time!

HOW ARE YOUR BLOW-OFF VALVES?

Are they drop-tight? Rugged and dependable? Easy to maintain?

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Yarway Unit Tandem Blow-Off Valve for higher pressures. Combines Yarway Seatless Valve and Yarway Hard-Seat Valve, or two Yarway Hard-Seat Valves in a one-piece forged steel body. For years—the choice of 4 out of 5 high pressure power plants.

YARWAY blow-off valves

Idaho

●Black, George J., Idaho Falls

Illinois

●Dahl, Robert R., Chicago
Fritts, Donald M., Oak Park
Insley, Robert, Chicago
●Johnson, Richard A., Park Ridge
Miller, Samuel P., Oak Lawn
Orland, Osmund, Aurora
●Schaid, Rodney J., Chicago
Voss, Frederick J., Chicago

Indiana

●Blue, Donald E., Indianapolis
Hansing, Ronald F., Elkhart
Maier, Carl O., Hammond
Trabant, Edward A., W. Lafayette

Kansas

●Johnson, Carroll E., Prospect
Lindahl, Paul A., Overland Park

Kentucky

Howes, Craig P., Henderson

Louisiana

●Denson, Leonidas L., New Orleans

Maryland

Arndt, Raymond H., Baltimore
Faxon, Harold C., Chevy Chase
Hillabrand, Carroll N., Aberdeen
●James, David T., Frederick
Kerley, James J., Jr., Cheverly
●Rivello, Robert M., Silver Spring

Massachusetts

Calderaro, Eugene, Springfield
Connell, Arthur J., Boston
Eckler, Richard C., Wayland
Wilson, David G., Cambridge

Michigan

Collins, Marshall E., Jackson
Johnston, John F., Jr., Grand Haven
Nicholls, George L., Midland
Rogo, Casimir, Detroit

Missouri

Jones, Dougan L., Kansas City

New Hampshire

Collinge, David, Portsmouth
Eckhart, William H., Greenland

New Jersey

●Daman, Ernest L., Westfield
●Ferguson, Oscar, Jr., Port Norris
●Lewis, Albert D., Vineland
Ryan, William F., Newark
Salvatore, Vito, Newark
Sidun, Albert, Berkeley Heights
Spat, Melvin, Weehawken
Valek, Edward, Guttenberg

New Mexico

Beveridge, John H., Los Alamos

New York

Beaulieu, Adelard R., New York
●Bishop, John W., Mineola
Carmi, Arieh, Corning
Cotton, Kenneth C., Scotia
Cuerou, Thomas R., Baldwin
Curran, Robert M., Schenectady
DeCotiis, Constant J., New York
Dragos, John, Rochester
Furrer, John R., New York
Harford, James J., New York
Hottenstein, Elmer R., Schenectady
Kovats, Andre, New York
Lundy, Robert J., Olean
Mains, Robert M., Schenectady
Meisels, Irving M., Brooklyn
Peck, Theodore H., Rochester
Stutzbach, Fred M., New York

North Carolina

Frost, Charles S., Charlotte
Rayburn, Walker H., Raleigh

Ohio

Coombs, Cornelius K., Cincinnati
Edwards, Robert J., Alliance
Flowers, Daniel F., Findlay
Griffin, James H., Portsmouth
Haramis, George T., Akron
●Hardgrove, George A., Madeira
Horvath, Anthony G., Dayton
Hurd, Claud C., North Canton
Ireland, Madison G., Barberton
Recko, Chester S., Cleveland
Skirvin, Stanley C., Cincinnati
Wylam, Clarence C., Cincinnati

Pennsylvania

Alley, Rembert C., Erie
Berbaum, Howard M., Pittsburgh
Bredin, Robert M., Huntingdon Valley
Conrad, Ralph W., New Florence
Faulds, Stanley C., Landenberg
Heimer, Roger C., Ardmore
Hoffman, John M., Bangor
●Inglese, Louis, Catasauqua
Kropp, Paul E., Allentown
Teplitz, Alfred, Monroeville
Valdez, Edward P., Johnsville

Rhode Island

MacLeod, Donald R., Kenyon
Pepin, William F., Norwood

South Carolina

Jones, Cap P., Aiken

Tennessee

Camp, William H., Old Hickory
Eudy, Paul H., Alcoa
●Lundin, Myrin I., Oak Ridge

Texas

Bell, Joe W., Sulphur Springs
Kappele, Jerome A., Baytown
Lindinger, Joe L., Houston
Mitchell, Gene A., Houston
Nelson, Paul M., Houston
Russell, Marvin L., Houston
Stringfellow, Jack C., Dallas

Virginia

Gill, Charles A., Richmond

Washington

Alexander, Daniel E., Seattle
Diediker, Donald M., Richland
Miller, John S., Seattle
Wall, Robert R., Richland

West Virginia

Carr, William H., Mannington
Miller, LaVerne L., Charleston
Riffe, Jay A., Charleston

Wisconsin

Bartholet, Emil J., Milwaukee
Staats, George P., La Crosse

Foreign

Delano, Tomas A., Santiago, Chile
Demain, Stanley W., Cornwall, England
Kitano, Hiro O., Hyogo, pref., Japan
Krywitsky, Leo, Toronto, Ont., Can.
Mahboob-Ali, Mohammad, Hyderabad, India
Mallcott, Frederick L., Caracas, Venezuela
March, John D. G., Victoria, Australia
Mehta, Dilip C., Bombay, India
Mussenden, Henry A., Jr., Bogota, Colombia
Pickering, John A. C., Point-Fortin, Trinidad
Raffray, Jean, Rivier Du Rempart, Mauritius
Sahgal, Kishan L., Ballarpur, Chanda, India
Smart, Ivor H., London, England
Tamney, Dalton D., Montreal, Que., Can.

Transfers from Student Member to Associate Member.....214

Obituaries

Ernest Karl Bastress (1906–1956), development engineer, Surface Combustion Corp., Toledo, Ohio, died March 4, 1956. Born, Sharon, Pa., Aug. 18, 1906. Education, graduate, Sharon High School; one year, Westminster College, 1924. He held three mechanical design patents on mechanical handling equipment. Mem. ASME, 1951. Survived by wife, Evelyn and a son, Ernest, Jr., Short Hills, N. J.

Nelson Allen Batchelder (1879–1956), retired general manager and director, Empire Cotton Mills, Ltd., division of Woods Manufacturing Co., Ltd., Welland, Ont., died Feb. 23, 1956. Born, Warwick, R. I., Sept. 27, 1879. Parents, Daniel W. and Adra C. Batchelder. Education, special engineering degree, Rhode Island State College, 1898; postgraduate study, New Bedford Textile School. Married Sarah Helen Franklin; son, Nelson. Held patents in United States, Canada, and Great Britain on developments in textile-manufacturing technology in dyeing processes, spinning, and weaving improvements. Mem. ASME, 1920. Past-president of New England Textile Club. In 1955 was elected honorary member of National Association of Cotton Manufacturers—being the fifth individual to be accorded this honor.

Elias Hyrum Beckstrand (1870–1956), retired professor of mechanical engineering, University of Utah, Salt Lake City, Utah, died Feb. 14, 1956, at Long Beach, Calif. Born, Medow, Utah, March 11, 1870. Parents, Elias August and Henrietta Cecilia (Carlson) Beckstrand. Education, BSEE, University of Michigan, 1900; MME, Cornell University, 1901. Married Agnes Josephine Dahlquist in 1908; son, Robert Gail. Mem. ASME, 1908. Survived by wife, Agnes, and son, Robert.

Frank Joseph Beles (1917–1956), research engineer, Johnson Service Co., Milwaukee, Wis., died Feb. 28, 1956. Born, Milwaukee, Wis., Jan. 16, 1917. Parents, Ignatius and Anna (Ondrias) Beles. Education, Mechanical-engineering course, Milwaukee Vocational School, Technical Engineering Division, May, 1951; Associate in Applied Science, Technical Engr., Milwaukee Institute of Technology, May, 1952. Married Nancy J. Fox, 1944. Assoc-Mem. ASME, 1951. Survived by wife and three children, John F., Raymond P., and Patricia A.

Francis Blossom (1870–1956), a partner in Sanderson & Porter, engineers and constructors, New York, N. Y., died March 12, 1956, at his home. Born, Brooklyn, N. Y., Oct. 17, 1870. Parents, Josiah B. and Grace (Ludlam) Blossom. Education, attended Polytechnic Preparatory Country Day School, Brooklyn, 1880–1887; CE, Columbia University School of Mines, 1891. Married Madeline Buck, 1900 (deceased). Mem. ASME, 1902; Fellow ASME, 1941; Hon. Mem. ASME, 1943. After World War I, Mr. Blossom served as a consultant to the War Department on construction contract work. In 1940, Secretary of War Henry L. Stimson recalled him for similar duty. He was on the Army Construction Advisory Committee during World War II. He also served the Reconstruction Finance Corporation as advisory engineer of the Second Federal Reserve District. Survived by son, Dr. Dudley B., Greenwich, Conn.; a daughter, Mrs. June Magee, New York, N. Y.; two sisters, and three grandchildren.

Burton Nelson Bump (1868–1956), one of the last surviving links with early days of the Solvay Process Co., Syracuse, N. Y., died Feb. 24, 1956, in Ridgewood, N. J. Born, Binghamton, N. Y., July 27, 1868. Education, ME, Cornell University, Sibley College, 1892. Married Edith Calthrop (deceased). Jun. ASME, 1892; Mem. ASME, 1904. Survived by son, Dr. Calthrop Bump, Ridgewood, N. J., and a daughter, Mrs. Charles R. Brooks, Monroe, N. Y.

Thomas Edward Butterfield (1873–1956), emeritus professor of heat-power engineering, Lehigh University, died Feb. 25, 1956, at Allentown, Pa. Born, Jersey City, N. J., June 12, 1873. Parents, James and Jane (Williams) Butterfield. Education, ME, Stevens Institute of Technology, 1895; CE, Rensselaer Polytechnic Institute, 1897. Married Susie Parker Palmer, 1913 (died 1928). Mem. ASME, 1912. He served the Society as secretary, Lehigh Valley Section. Author, "Heat Engines" and several technical papers published in professional journals. Survived by four children: Thomas E., Jr., Bethlehem, Pa.; John P., Grosse Pointe, Mich.; Mrs. George L. Griffin, Jr., Coopersburg, Pa.; and Mrs. Theodore G. Heck, Levittown, Pa.

Charles Arthur Jackson (1879–1956), for many years chief engineer of the Eastern Division, Pelton Water Wheel Co., New York, N. Y., died Jan. 19, 1956. Born, Austinville, Va., July 27, 1879. Parents, Michael J. and Margaret Ellen (Warrick) Jackson. Education, BS(ME) Virginia Polytechnic Institute, 1901. Married Bertha L. Delp, 1905. Mem. ASME, 1911. Survived by wife; a daughter, Virginia (Mrs.

(ASME News continued on page 602)

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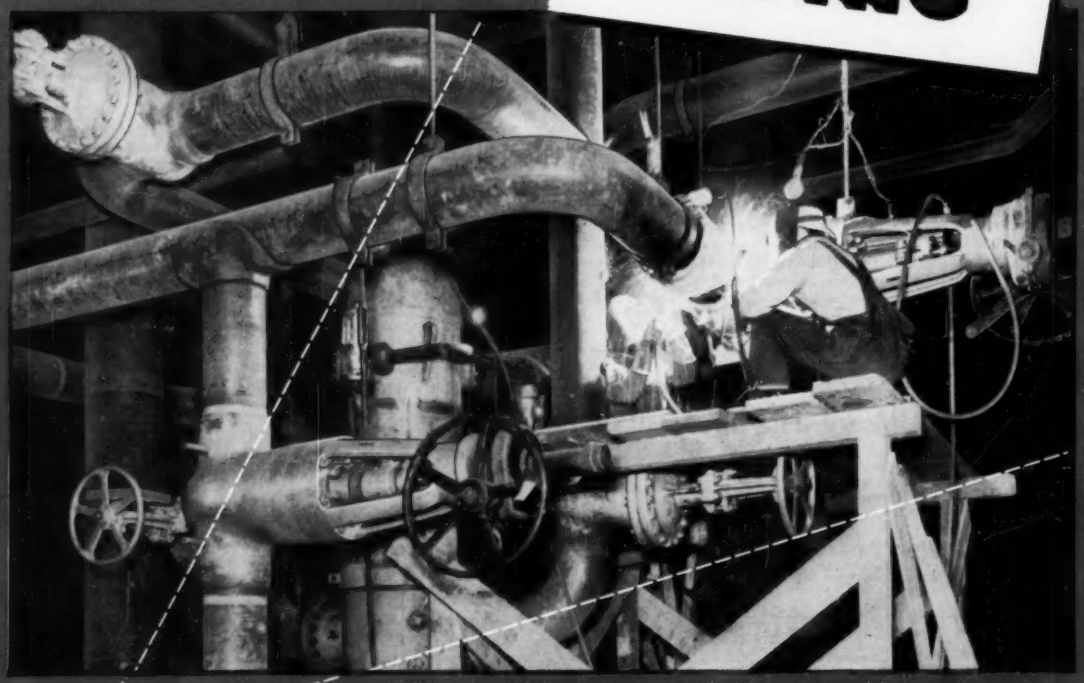

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From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information, you should be registered in the Division (no more than three) in which you are interested. Your membership card bears key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you are registered.

Consult the form on this page for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions enrollment are correct. Please check whether you wish mail sent to home or office address.

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POSITION TITLE
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NATURE OF WORK DONE

NAME OF EMPLOYER (Give complete name in full)

Division, if any

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☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

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☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
☐ F—Fuels	☐ O—Lubrication	☐ Y—Rubber and Plastics
☐ G—Safety	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ Q—Nuclear Engineering	

(Continued from page 600)

Thomas A.) Jackson of Austinville, Va.; and two grandsons.

Harley Alden Johnson (1884–1956), retired manager, Rapid Transit Division, Chicago Transit Authority, died Feb. 6, 1956. Born, Ottumwa, Iowa, Dec. 8, 1884. Parents, Frank L. and Fannie S. (Randolf) Johnson. Education, BS(ME), Purdue University, 1905; hon. DE, Purdue University, 1935. Married Sadye Stallard, 1908. Carried on investigation and practical road tests which resulted in developing and adopting the Type AB freight brake as standard on American railroads. Author, "Power Brakes and Appliances for Operating Power Brake Systems"; contributed a number of reports and articles published in technical journals. Mem. ASME, 1934.

Harold L. Miner (1885–1955), retired member of the Du Pont Company, died March 5, 1955. Born, West Hartford, Conn., Oct. 30, 1885. Parents, Alfred N. and Emma Louise Miner. Education, high school and postgraduate course in Connecticut. Coauthor of the chapter on "Safety and Fire Protection," in the Chemical Engineers Handbook. Married Harriet W. Miner, 1912. Assoc-Mem. ASME, 1917; Mem. ASME, 1935. Survived by wife; daughter, Helen M. Miner; and grandson, Harold P.

Harold Edward Pilkington (1896–1956), standards engineer, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., died Jan. 5, 1956. Born, Chester, Pa., July 5, 1896. Parents, Edward J. and Caroline (Guthrie) Pilkington. Education, attended Drexel Institute and completed several ICS engineering courses. Married Reba L. Dilks, 1929. Mem. ASME, 1949. Received a certificate of honor from Du Pont Co. for outstanding war work in Design Division in 1945. Survived by wife; two daughters, Helen Reier, Baltimore, Md., Carolyn Howard, Boothwyn, Pa.; and a son, Claude R., Woodlyn, Pa.

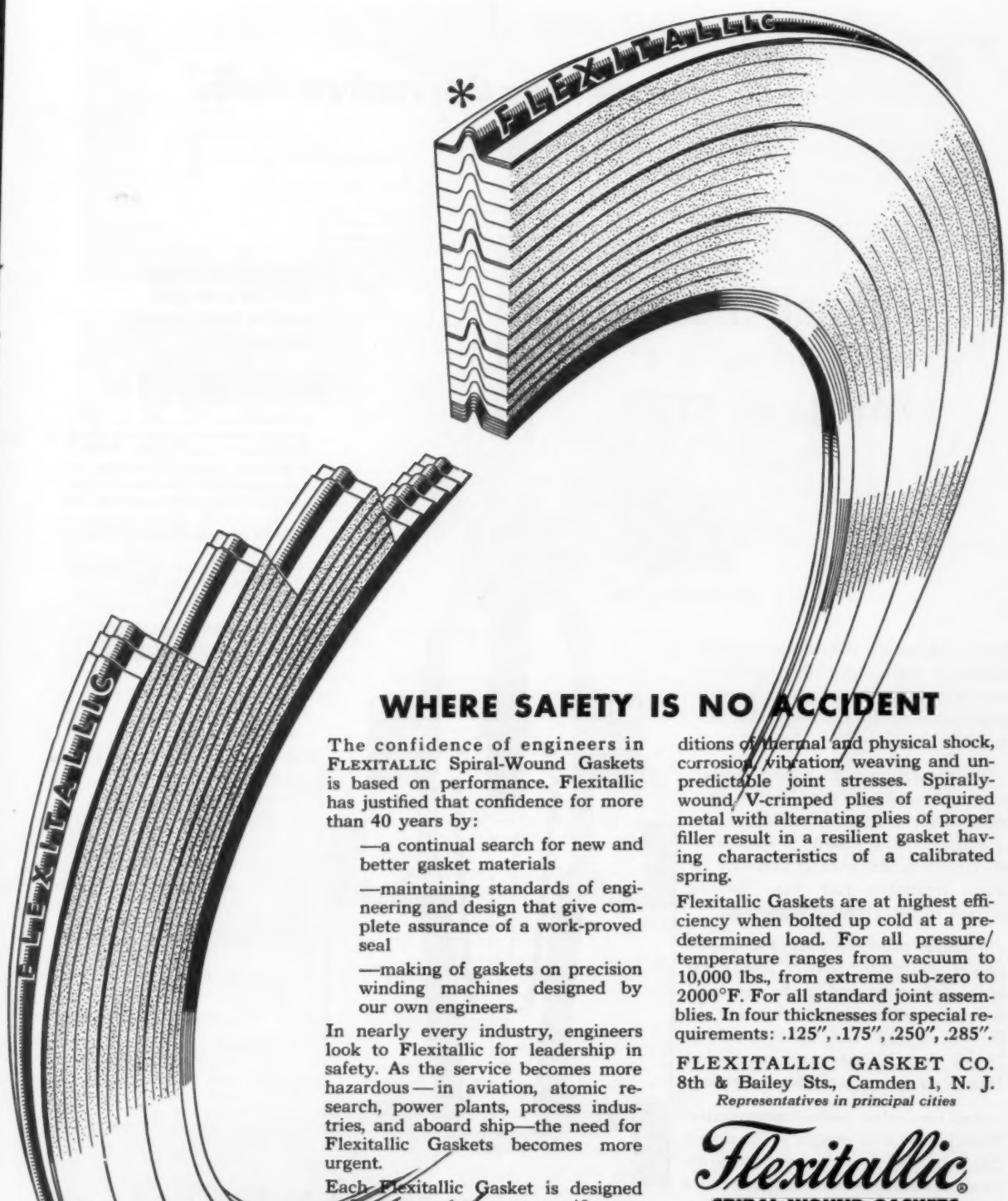
William H. V. Rosing (1859–1955?), whose death was recently reported to the Society, was consulting engineer, Gulf Coast Lines at the time of his retirement in 1921. Born, Cincinnati, Ohio, March 8, 1859. Education, three years at Massachusetts Institute Technology. Mem. ASME, 1896.

Raymond N. Ruiter (1892–1955), project manager, specializing in boiler and power plants, Rust Engineering Co., Birmingham, Ala., died Dec. 12, 1955. Born, Cowansville, P. Q., Can., June 28, 1892. Parents, Nelson and Eleanor (Taylor) Ruiter. Education, graduate, Northampton (Mass.) High School; attended Worcester Polytechnic Institute. Married May Leonard, 1920. Mem. ASME, 1942. Survived by wife.

David Whyte Stewart (1889–1955?), whose death was recently reported to the Society, was for many years chief engineer, New Orleans Public Service, Inc., New Orleans, La. Born, Kirkcaldy, Scotland, Dec. 13, 1889. Parents, John and Jeannie (Ferguson) Stewart. Education, preparatory public school and private high school; six years' apprenticeship in mechanical engineering and attended night school. Naturalized U. S. citizen, New Orleans, La., June 28, 1921. Married Olga Carlstrom, 1915; children, Cecelia Carlstrom and Katherine Ferguson. Assoc-Mem. ASME, 1922; Mem. ASME, 1935; chairman of New Orleans Section, 1934; member New Orleans Section Executive Committee, 1940.

O. C. Thompson (1875–1956), retired mechanical engineer, died March 11, 1956. Born, Petersburg, Va., Dec. 22, 1875. Parents, Tecumseh Holt and Emma Rebecca (Harvell) Thompson. Education, BS(ME), Virginia Polytechnic Institute, 1896; two years postgraduate in mechanical engineering at same Institute. Married Mildred Maurine Manley, 1915; children, Dr. Mildred T. Bohne, Robert E., and the late Ensign William M. Thompson who lost his life at Pearl Harbor in 1941. Held 14 patents on stapling and box assembling machinery. Assoc-Mem. ASME, 1910; Mem. ASME, 1915.

William Laurence Waters (1879–1956), retired engineer, died March 11, 1956. Born, London, England, Sept. 7, 1879. Parents, William and Ellen (Turnbull) Waters. Education, Central Technical College (London University), ME, CE, EE, 1897 and 1898. Married Hilda Johnston, 1906; one daughter, Carolinda. Married 2nd, Mildred M. Warner, 1912. Was partner in Bury & Waters, consulting engineers, New York, N. Y. and London, England, with Sir George Bury (formerly senior vice-president, Canadian Pacific Ry.). Held numerous patents. Author of several papers and articles on rail and highway transportation in England and U. S. Mem. ASME, 1909. Survived by wife and daughter, Mrs. Lee J. Fischer, Jr.



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for lower cost control of moderately **Corrosive** fluids

Fig. 2651-A Gate

JENKINS

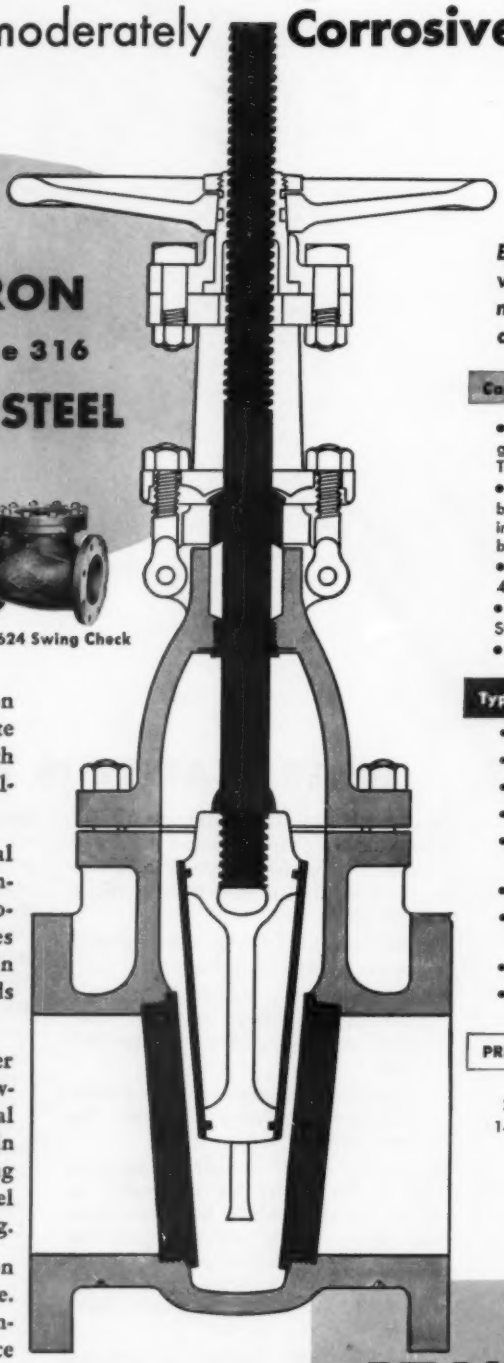
NICKEL IRON

Valves with Type 316

STAINLESS STEEL

Trim

Fig. 2624 Swing Check



Every part in contact with fluid is the right metal to block corrosion and beat wear.

Cast NICKEL IRON

- **BODIES** Heavy duty, dimensioned for greater resistance to wear and abuse. Through port design in Gate Valves.
- **BONNET** Rugged construction, like body. Swing-type gland bolts. Screwed-in back-seating bushing. Deep stuffing box.
- **YOKE** Integral with bonnet in 2″ to 4″ sizes.
- **WEDGE** In 10″ to 24″ sizes, with Stainless Steel Wedge Rings.
- **COVER** In Check Valve.

Type 316 STAINLESS STEEL

- SPINDLE
- GLAND
- BONNET BUSHING
- SPINDLE WING
- WEDGE of I-beam structure in 2″ to 8″ sizes.
- WEDGE PIN
- WEDGE RINGS Rolled into Nickel Iron Wedge in 10″ to 24″ sizes.
- SEAT RINGS
- DISC and HANGER in Check Valve

PRESSURE RATINGS

2″ to 12″—200 lbs. O.W.G.
14″ to 24″—150 lbs. O.W.G.

This combination provides corrosion resistance well above the moderate need in many processing services with an investment well below that for all-stainless steel valves.

Designed primarily for the chemical process industries, they are recommended for control of mildly corrosive liquids with minimum quantities of mineral acids, such as creosote in wood treatment, and many liquids carried in petroleum processing.

A major use is in pulp and paper processing, particularly in lines serving the digester, and in the chemical recovery cycle. Service records in lines carrying the valve-punishing "black liquor" give Jenkins Nickel Iron Valves top performance rating.

Jenkins *extra value* construction throughout. Get details — compare. See why they stretch your valve investment dollar — with longer service life, lower maintenance cost.

ALSO RECOMMENDED for fluids used in electroplating, photograph finishing, textile bleaching, dyeing and finishing and heat treating of metals.

GET COMPLETE SPECIFICATIONS from your Jenkins Valve Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17. Ask for Bulletin 118.

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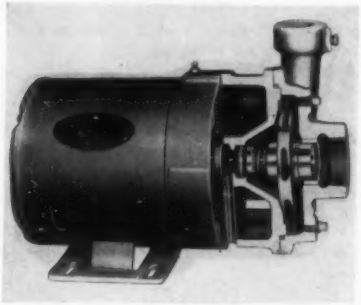
Available literature or information may be secured by writing direct to the manufacturer. Please mention MECHANICAL ENGINEERING

NEW EQUIPMENT

Tracing Vellum

Frederick Post Co., 3666 N. Avondale Ave., Chicago 18, Ill., announces an improved tracing vellum said to have better erasability. Called Blutex, the product is actually a revised formulation of an established vellum.

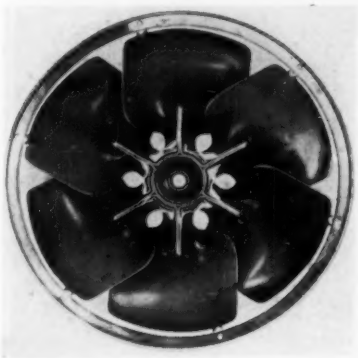
The company says chief reason for the easier erasing qualities is a new combination of transparentizing materials used in treating the base stock. Unlike some other vellums, Blutex is treated with 100 per cent synthetic resins rather than oils. The resins provide a "drier" working surface of unchanging characteristics. While dry, the paper is never brittle, the firm says.



Motor Mounted Pump

A compact, motor mounted centrifugal pump designed specifically for air conditioning service has been announced by Deming Co., Salem, Ohio. The new units are also said to be suited for general circulating duty, industrial plant service, swimming pools and lawn sprinkling. Sizes range from 1/3 to 5 hp with capacities to 140 gpm.

Design features include all bronze, enclosed type impeller; renewable, bronze wearing ring; stainless steel shaft; and rotary type shaft seal. Casing may be turned for horizontal or vertical discharge. Suction and discharge nozzles are cast integral with casing and threaded. Drain, vent and priming connections are provided. Motors are ball bearing, single or three phase, 3450 rpm, equipped with grease lubricated bearings.



Six-Bladed Fan

A low-cost six-bladed fan with reduced axial depth has been developed by Torrington Mfg. Co., Torrington, Conn., primarily as a condenser fan (with a slinger ring) in room air conditioners.

Available also with four blades, the Type C-12-6 axial-type impeller has a 12-in. tip diameter and can be used with either a solid or rubber-bushed hub.

With or without the slinger ring shown in the photo, the new fan may be obtained in a wide variety of pitches. The six-bladed model includes three two-bladed one-piece sections precisely nested together and secured by the hub. The slinger ring is made in one piece, and the slinger-ring tabs are part of the blades themselves.

Axial depth of fans in the Type C-12-series varies from $1^{15}/_{16}$ to $3^{9}/_{16}$ in.

Voltage Booster

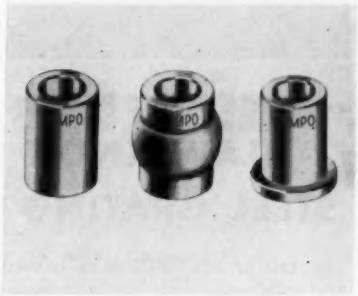
A newly developed portable electric power unit, the Portopower voltage booster, designed to deliver additional voltage in construction work where power tools are used, has been introduced by Portopower Div., 1511 E. Nine Mile Rd., Ferndale 20, Mich.

The booster is equipped with a voltage meter for checking delivered operating power, a 5-position voltage increase switch, each position providing a 10-volt step-up in voltage output. In the operation of a portable power saw, the unit can be attached to replace voltage lost through use of an extension cord, from service drop to point of operation. Under these same conditions the voltage booster can also be used to step up operating speed of the power saw, reducing cutting time as much as 30 per cent, the company says.

O-Ring Compound

What is described as a completely new O-ring compound has been developed by Precision Rubber Products Corp., Dayton, Ohio.

The compound identified by the manufacturer as 730-70 meets the requirements of high temperature systems in sonic military aircraft operating with MIL-O-5606 hydraulic fluid. It meets MIL-P-18017B(ASG) and its predecessor specifications. The firm says the compound has the greatest temperature range of any existing Buna N material now known to be suitable for a petroleum base hydraulic fluid. Its temperature range of −65 to 275 F has been established by exhaustive performance testing.



Bearing Compound

Compo E, a new powder-metallurgy compound developed for the production of low-cost oil-retaining bearings has been made available for general use by Bound Brook Oil-Less Bearing Co., Bound Brook, N. J.

The firm says the development bridges the gap between the company's Powdiron sintered iron and Compo porous bronze. Composed of approximately equal parts of iron and bronze, it combines the economy and strength of iron with the anti-friction and long-life properties of bronze, the company states. While primarily intended as a low-cost, general-purpose bearing material, it can also be fabricated into sintered structural parts.

Extensive field testing of the compound has proven it to be suited for applications where quiet operation is an essential, including fan motors, air conditioning motors and drives, record players, tape recorders, and home laundry equipment. Complete data covering chemical analysis, physical properties and operating characteristics will be supplied on request to the company

... make every step a safe step

BLAW-KNOX ELECTROFORGED® STEEL GRATING and STAIR TREADS

On stair treads, walkways, catwalks, platforms and floors—both indoors and outdoors—you can provide safe walking conditions. For Blaw-Knox Electroforged Steel Grating brings you these exclusive features:

1. rigid one-piece construction—easy to install
2. non-slip twisted crossbar—for safe footing
3. three types of bearing bars
   - square bars—for smoothest walking surface
   - knurled bars (Furro-Grip)—for extra safety plus relatively smooth walking surface
   - serrated bars—for maximum safety under extremely hazardous skid conditions
4. no sharp corners to clog—self-cleaning
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—or send dimensional sketch for quotation.

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Fluid Drive Line

American Blower Corp., Detroit 32, Mich. has developed a new series of Class 2 adjustable speed Gyrol fluid drives for 1 through 25 hp applications. The company says the new units are especially well suited for automated installations where minimum maintenance, automatic speed adjustment, and positively uniform accuracy of repeat speed settings are prime considerations.

Being adjustable speed fluid drives, the units protect drive motors and driven machinery from shock loads, torsional vibration and excessive torque, the firm states. They can be used with conventional single-speed electric drive motor to provide adjustable, stepless speed control. Speed adjustment can be manual or automatic. Where a two directional motor is used, the fluid drive and load can be reversed while in motion by merely changing motor rotation.

The fluid drives are self-contained units. All moving parts are continually bathed in large volumes of oil. A complete change or chemical analysis of oil once a year is the normal maintenance requirement, the company states.

Output shaft speed is altered during operation by varying the amount of oil in the fluid drive's working circuit. Working oil level is controlled by a sliding scoop tube mechanism which is readily adapted to any known method of automatic actuation. Power transmission is accomplished through the fluid drive hydraulically; there is no metal-to-metal contact. It is therefore possible, the company says, to return again and again to the same speed setting position in the fluid drive and obtain identical output shaft speeds.

Pressure Pickup

A pressure pickup, which is said to more than double the existing temperature range for this type of transducer, has been announced by Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

Designated Type 4-316, it operates continuously up to 600 F, providing accurate pressure measurement under the most extreme environmental conditions yet imposed on such instruments, according to the company. The pickup is available in both gage and differential types.

The unit is $\frac{1}{2}$ in. in diameter, $\frac{3}{4}$ in. long, weighs 15 grams with its 30 in. of insulated, permanently attached, 4-conductor cable.

Unbonded strain-gage windings connected in a four-arm bridge comprise the sensing elements of this variable-resistance-type transducer. Pressure against the diaphragm produces a displacement of the sensing element, changing the resistance of the active arms and causing an output proportional to the applied pressure. Acceleration and vibration are cancelled by the geometry and winding arrangement of the star-spring-type sensing elements, and have little net effect on bridge output, the firm states.

KEEP INFORMED

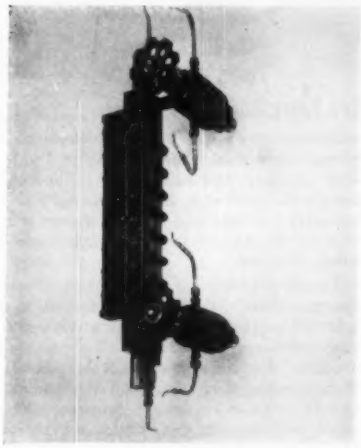
NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Pressure Reducing Valve

A new air loaded, diaphragm operated, pressure reducing valve for steam heat and steam applications is announced by Leslie Co., Lyndhurst, N. J.

The Class GPK valve has a design with only two moving parts: a unique metal diaphragm with full valve travel and a hardened stainless steel main valve that seats on a renewable stellited seat ring. A simple air loader replaces the conventional loading spring, and produces a constant loading force on the diaphragm. The design assures the same control point over full valve travel, according to the firm.

It is available in cast iron in sizes 1/2 to 2 in. with screwed end connections. Inlet pressure range is 0–250 psi, 450 F. Used with the firm's Class A air loader or Type P panel mounted loader, the reduced pressure range is 0–85 psi; or, up to 249 1/2 psi with any suitable high pressure loader.

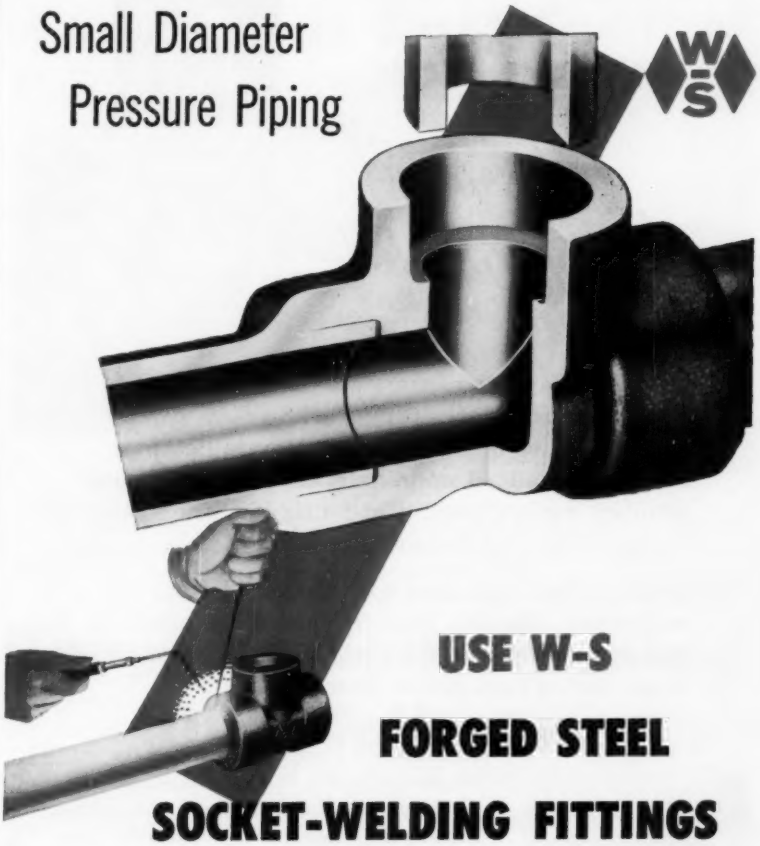


Heated Gages

Jerguson Gage and Valve Co., Somerville 45, Mass., announces the development of an electrically heated gage. The units are designed for use where there is the problem of heating cold liquid such as waxes, to get an accurate reading,—or in cold weather applications to prevent gage freezing and breakage, but where steam is not available for heating. The firm says the electrical system also is valuable where there is need for very close control of temperatures in the gage glass. An electrical unit may be installed with a temperature control or thermoswitch positioned within the gage column to regulate the amount of heat output of the electrical element.

Gages are available in double-chamber reflex or external tube transparent gage models in various sizes and pressure groups. The jacketed cocks are available with connections screwed, for socket welds, or flanged, and may be furnished with or without ball checks. Any of the above units may be fur-

Here's the **EASY WAY TO WELD**
Small Diameter
Pressure Piping



USE W-S
FORGED STEEL
SOCKET-WELDING FITTINGS

In addition to providing high strength and toughness, W-S Forged Steel Socket-Welding Fittings are also easy to install. Deep sockets support and align the pipe for welding... eliminating the need for tack welding or special fixtures. No back-up ring is needed either. The fillet-weld is completely outside the pipe. Welding icicles just can't form inside the pipe. The result is a clean, tight welded joint that will readily resist high pressures and the stresses of shock and vibration. What's more, installation costs are lower.

W-S Socket-Welding Fittings are available in sizes 1/8" to 4" for schedule 40, 80, 160 and double-extra heavy pipe in carbon steel, stainless steels and alloy steels.

For complete information on the installation and operation advantages of W-S Forged Steel Socket-Welding Fittings, send today for Bulletin A-3-56.

W-S FITTINGS DIVISION
H. K. PORTER COMPANY, INC.
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...the best and most modern!

Bunting today covers a new area in the engineering and manufacture of bearings and machine parts. To the traditional line of Bunting Cast Bronze Bearings and parts is added up-to-date, soundly established facilities for engineering and manufacturing bearings and parts made of Sintered Powdered Metals.

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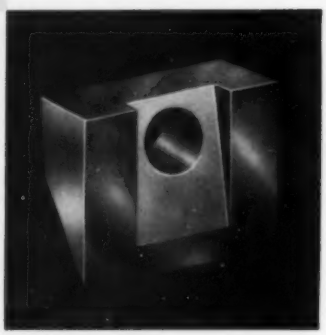
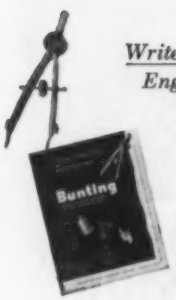
A competent group of Bunting Sales Engineers in the field and a soundly established Product Engineering Department put at your command comprehensive data and facts based on wide experience in the designing and use of Cast Bronze and Sintered Powdered Metal Bearings and parts.





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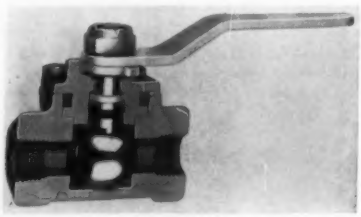
nished in any material required to meet corrosive conditions.

Where explosion-proof construction is required, the electrically heated units can be adapted to the requirements of the Underwriters' Laboratory. All materials used conform to or exceed the requirements of AISI, ASTM, and/or API-ASME. A special heat-resistant silicone paint is used for the protection of the external finish.

The heating element in the gage is a Chromalox unit for 120 or 240 volt a c, with wattage output to meet requirements. The valves are wrapped with resistance wiring with similar characteristics, and sealed in the metal jacket.



Top Entry Ball Valve

Worcester Valve Co. Inc., Worcester, Mass., announces production of its Twin-Seal top-entry ball valve, said to be the first on the market to incorporate both the top-entry for easy in-line maintenance and twin-seal for positive shut-off with flow from either direction.

The round opening in the ball allows piping to handle fluids with minimum turbulence in the line. The firm says the valve affords wiping action on both sides of the ball. The choice of naval bronze, aluminum bronze and aluminum allows handling of such media as air, butane, propane, freon, gases, hydrogen, oxygen, salt water, petroleum oils and many chemicals.

Seating materials available are Buna-N, Neoprene, natural rubber, Hypalon, Teflon. The company says replacement of seat rings can be accomplished quickly and easily without removing valve from line. A repair kit for in-line maintenance is also available.

Cantilever Support

A new cantilever-type support has been designed by T. J. Cope, Inc., Collegeville, Pa., for its expanded metal cable trough supporting systems. The firm says a twist of the wrist is all that is necessary to secure the arms to which the expanded metal cable trough is bolted. The arms themselves are secured to up-right channel irons with pre-punched holes that provide a wide number of possible settings.

The cantilever type of arm is said by the company to be popular for the support of cable trough as the cable can be lifted in over the side of the trough without any interference from up-rights supporting the arm itself.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Flexible Gear Coupling

A spacer type flexible gear coupling to make it possible to remove the hubs from either shaft without disturbing the mountings of the connected units has been developed by Sier-Bath Gear and Pump Co., Inc., 9284 Hudson Blvd., North Bergen, N. J.

The spacer type coupling consists of flexible hubs on both the driver and driven shafts. The center unit, or spacer, has specially designed teeth at either end cut in such a manner that they mate with each sleeve in a spline fit and have no flexibility. The two sleeves connect the driver and driven units through the spacer. The firm says the entire unit is assembled and uncoupled quickly without using wrenches or special tools.

The flexible gear couplings are made in standard stock models, sizes $^7/_8$ to 3, with capacities of 4 to 80 hp per 100 rpm.

Special Lift Truck

Market Forge Co., 35 Garvey St., Everett, Mass., has developed a straddle hand lift truck which is claimed to reduce costs in handling ingots of aluminum, lead, and other materials.

Especially designed to accommodate leg clearances under two in., the truck handles short hauls and load maneuvering, thereby freeing power fork trucks for other, more important work. With the hand lift truck, one man can handle a 2500-lb load of ingots, unloading five units in 25 minutes, the firm states.

The pig hand lift truck utilizes the company's standard hydraulic system and steering mechanism. The supporting legs are strapped to the pile of ingots are made of the same material, so that they can be placed directly in the furnace, leaving only the steel strapping.

The company lists specifications for this truck as follows: overall width - $37^1/_2$ in; distance between wheel fork members, in-to-in - 29 in.; fork lengths - 30 in.; over-all width of forks, out-to-out - $14^3/_4$ in. - in-to-in - $8^3/_4$ in.; forks are $1^1/_2$ in. thick; Lift - 4 in.

Sealing Compound

A new type of liquid sealing compound called "Slic-Seal" has been marketed by Hoke, Inc., 211 S. Dean St., Englewood, N. J., for use in eliminating galling of pipe threads and to act as a thread sealant.

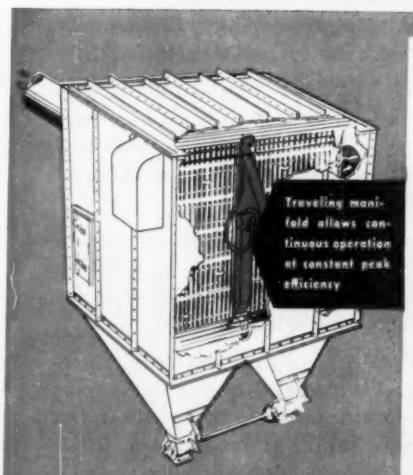
The compound, a dispersion with a Teflon base, is completely inert to all known chemicals except molten alkali metals, fluorine at high temperatures and certain complex halogen compounds, the company says.

Besides its application on pipe threads, it can also be used in the laboratory to cast a film for capacitor layer insulation and diaphragms, to impregnate porous bearings, to provide a corrosion resistant surface to protect equipment, and to impregnate asbestos fabric and braid for gasket and packing use.

For Efficient Continuous Dust Control

U. S. GYPSUM CO., St. Paul, Minn., manufacturers of building materials, occasionally operates for 120 hours at a stretch. The nature of the work permits no shut-down of dust collecting equipment during this time. For continuous and effective dust control, U. S. Gypsum uses a Pangborn Self-Cleaning Cloth Screen Collector. It meets all production requirements, keeps employee morale and efficiency high, and salvages 40 cu. ft. of powdered material for re-use during an average 8-hr. shift.

Pangborn Self-Cleaning Dust Collector



The Pangborn Self-Cleaning Collector combines the proved efficiency of the cloth screen collector with continuous automatic operation. A manifold with integral blower slowly traverses the clean air outlets of the screen frames. Covering three rows of screens at any given time, it applies a reverse air current through the center row to remove collected dust from the cloth surfaces. The result is continuous operation providing constant air volume and suction with high collecting efficiency, but operating at lower cost and requiring less space.

Pangborn CONTROLS DUST

If *your* operations require efficient, *continuous* dust control, write for details on the Pangborn Self-Cleaning Dust Collector. Send for Bulletin 915 to PANGBORN CORP., 2200 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control and Blast Cleaning Equipment.*

Standardaire Blower unloads 20 tons of flour in 50 minutes

In the next 50 minutes, this one operator will have unloaded twenty tons of flour from this huge International Milling Company trailer directly into a baker's storage bins.

The problem of rapidly unloading flour in such quantity, with no leakage, clogging or contamination, was solved by a *Standardaire* blower . . . the only blower found capable of meeting all the specific requirements involved.

This blower (shown in the front of the van) occupies a floor space of only 26″ x 21¾″. When driven by a 20 hp motor it provides an air flow sufficient to move flour as far as 125 feet in any direction . . . including straight up.

Today, due to its proved satisfactory performance, International Milling Company, Minneapolis, one of the largest millers of bakery flour in America, has equipped its entire fleet of bulk flour trucks with *Standardaire* blowers.

A *Standardaire* blower will deliver more air, with less power consumption, than any other unit of equal size or weight. Find out about its many advantages. Write for bulletin B-154 today.

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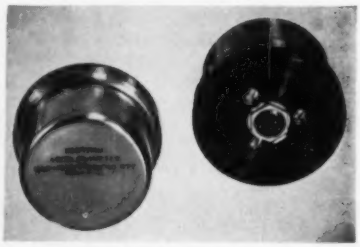

Telemetering Accelerometer

North American Instruments, Inc. has announced the addition of a new accelerometer to its line of transducers. The Model A-7T accelerometer is a variable inductance transducer for use in FM-FM telemetering systems.

It is intended for static and dynamic measurement of linear acceleration and is available in ranges from ±1 g to ±100 g. Overloads of four times rated range or of 60 g, whichever is greater, will not damage the unit, the firm states.

Standard A-7T accelerometers are damped to .7 critical over the temperature range −65 to +160 F with silicone oil. The unit is insulated and an internal temperature of 160 F is thermostatically maintained to provide good stability and constant damping regardless of ambient temperature from −65 F to +160 F. It will operate in temperatures up to 300 F for short periods of time with no loss of accuracy.

The seismic system consists of a mass supported by a cantilever spring; motion of this mass is detected by an E-core-coil arrangement. The company says the small motions necessary provide a stiff mechanical system which allows a high resonant frequency and excellent frequency response. The electrical characteristics are such that the instrument will operate in conjunction with an inductance type sub-carrier oscillator. Two standard types are available; one to operate on No. 4, 5 and 6 RDB band with nominal inductance of .8 henrys and the other to operate on No. 7, 8, and 9 RDB band with nominal inductance of .15 henrys. The Q of both types is greater than 6.

Surfacing Material

Durametallic Corp., Kalamazoo, Mich., announces a new development for improved mechanical seal facing called No. 55 facing material. The material is described as providing a wear-resistant, high refractory coating of pure oxides. It is applicable to the basic seal parts made of steel, bronze, aluminum, stainless steel, monel or other alloys.

The coating is claimed to be highly resistant to thermal or physical shock and corrosion, and seals with a very low coefficient of friction at the contact surfaces. The firm reports that the material retains its original micro-finish flatness and is not subject to the usual strains and stresses found in various hard surfacing materials.

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Shaded Pole Motor

A new totally enclosed, shaded pole motor, designed for high output applications such as ceiling hung gas fired unit heaters, has been developed by the General Electric Co. Specialty Component Motor Dept., Schenectady 5, N. Y. With a "sealed-in" lubrication system, this motor is said to require no reoiling or service under normal use.

Available in ratings from $^1/_{15}$ through $^1/_{10}$ hp, the 39-frame motor has a diameter of $5^1/_2$ in. With the addition of the new ratings, the totally enclosed line of shaded pole motors ranges from 1.5 watts output through $^1/_{10}$ hp at both 4- and 6-pole speeds. In the firm's open motor design, the shaded pole motor construction extends through $^1/_4$ hp.

A special oil pump groove on the motor's shaft provides continuous replacement of cooled, filtered oil on bearing surfaces, in order to extend bearing life, the firm states.

Flow Control Valves

A new line of "quick-dump" flow control valves, said to incorporate a basic improvement in design, has been placed in production by Humphrey Products, a subsidiary of General Gas Light Co., Kalamazoo, Mich. These valves are intended for use in original equipment, as well as applications that require either manual or automatic valving of air, water, oil or freon.

The line utilizes a single basic valve body which may be used either normally open or normally closed, depending upon port connections. To this standardized valve body may be added a variety of simple devices for triggering the valve action, the firm explains.

Seven models are currently available: solenoid, cam operated, palm button, fingertip, foot operated and two types with hand lever.

The manufacturer explains the opening, closing, and holding action are effected by the pressure of the air or liquid. Because the valving action works with the pressure instead of against it, it is claimed that all performance characteristics are enhanced.

There are no internal packings, springs, or pistons, no sliding of metal-to-metal contacts in the valve. Wear is said to be reduced to a minimum and service life is greatly prolonged.

The valve body is machined from solid bar steel with corrosive resistant finish and is equipped with Buna-N rubber diaphragms. Valve is adapted for applications up to 125 lb psi and under temperature variations from −40 to 225 F.

The solenoid operated valve has a momentary electric impulse to trigger it to open or close positions. No current is required to hold since there is no prolonged flow of current. Danger of over-heating the coil is said to be eliminated, and solenoid life is lengthened. A new type of double coil, impact solenoid, has been developed for this valve. This solenoid develops greater thrust from smaller coils.

CONSOLIDATED builds both large and small CHIMNEYS!

This huge chimney is only one of the three required for a modern generating plant with tremendous electrical output . . and Consolidated designed and built it. Not the largest chimney in the world, but a tremendous job nevertheless; skillfully executed to the complete satisfaction of general contractor and operator.

The chimney is 250 ft. high with a top inside diameter of 24 ft. and a bottom outside diameter of 36 ft. 9¼ in. It is of reinforced concrete construction built to withstand earthquake stresses with a brick lining the entire height. The air space between the lining and the concrete shell is insulated with fibreglass. A hopper is located within the chimney at the base. Weight of chimney is 1910 tons . . still another example of Consolidated's engineering and construction skills, and the adaptability to meet the most exacting requirements.

Consolidated has designed and built chimneys of all types and all sizes in the United States, Canada, Mexico and South America—Perforated Radial Brick, Reinforced Concrete, Face and Common Brick—Acid Proof; High Temperature. It installs linings for steel stacks, waterproofs, rebuilds and repairs; installs lightning rods and aircraft warnings; demolishes chimneys. Whatever your chimney problem may be, Consolidated has the experience, the knowledge, and the skilled personnel to handle it.

Free Inspection Service A Consolidated engineer will inspect your chimney at no inconvenience to you and make recommendations for increased life and efficiency when necessary This service places you under no obligation.

Phone, wire or write today for information. Ask for catalog giving installations, engineering service and chimney design data

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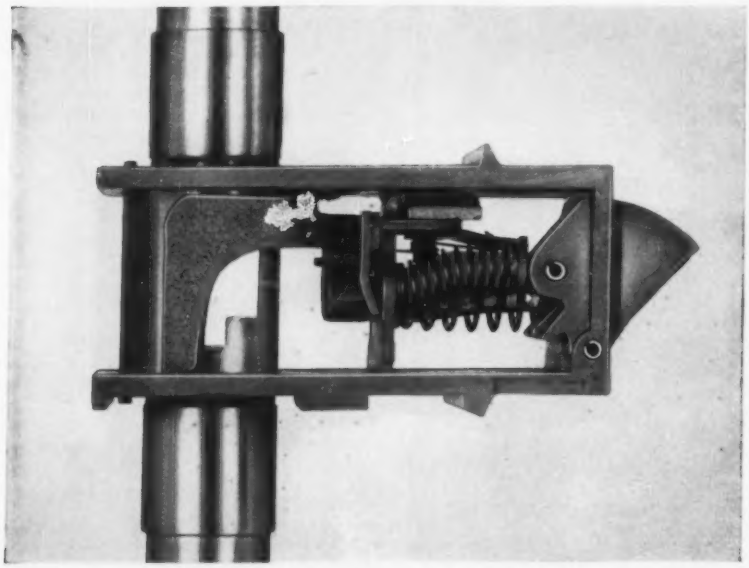

Lower hinge pin assembly cost for Corbin and Russwin locks

The American Hardware Company previously used solid steel hinge pins in the latch release mechanism of their line of door locks. However, in assembling the locks it was necessary to ream the holes for the pins and to stake them into place, which added to the assembly costs of the solid steel pins.

Stainless Steel Rollpin® drastically cut the cost of the hinge pin assembly because Rollpin is easily driven into standard drilled holes without reaming and the secondary staking operation was entirely eliminated. Rollpin compresses as driven, and its spring action locks it securely in place against vibration.

This simple fastener cuts cost in an infinite variety of applications. Rollpin quality control can be depended upon to guarantee uniformity in shear strength, hardness, dimensioning and high performance. Why not consider the opportunities it offers you for substantial savings as a locating dowel, rivet, clevis pin, or in place of set screws, tapered or grooved pins.

MAIL THIS COUPON FOR DESIGN INFORMATION — ROLLPIN TRADEMARK

Dept. R39-611, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send me the following free fastening information:

☐ Rollpin Bulletin

☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name_____ Title_____

Firm_____

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City_____ Zone____ State_____

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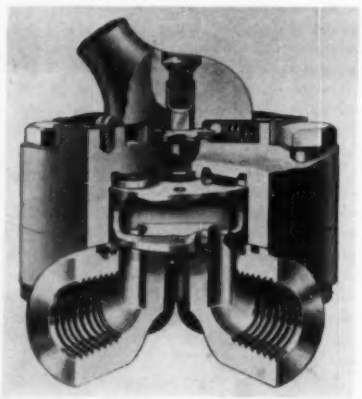
Bronze Rotary Pump

Dexter Folder Co., Pearl River, N. Y., announces a corrosion-resistant bronze rotary pump for vacuum and/or pressure applications in handling steam, hydrogen, natural or manufactured gas, nitrogen or other inert gases carrying entrained moisture. The firm states that the bronze construction of rotor and housing eliminates freezing due to water-vapor corrosion at the limited-clearance rotor extremities and housing end-plates.

A feature of the positive displacement pump are Graphitar vanes which, unlike cast iron, require no lubrication in riding against the cylinder wall.

The bronze pump, believed to be the first of its kind, is available in three models. Capacities range from 3.5 to 33 cfm and maximum continuous pressure is 20 psi. Maximum steady vacuum is to 20 in. Hg and maximum intermittent vacuum is 25 in. Hg. The pump is available with either single or double shaft extensions and may be furnished for either clockwise or counterclockwise rotation.



Selector Valves

Republic Mfg. Co., 15655 Brookpark Rd., Cleveland 11, Ohio, introduces a new line of selector valves in the 0 to 1000 psi pressure range. The firm says these valves give "no leak" service in their indexed position in most fluid services and recommends them for air, gases, hydraulic oil, non-aromatic fuel, petroleum, and water services. Operating temperature range is −65 to 160 F. Working pressures for air and gases are 0–500 psi; liquids, 0–1000 psi.

The valving disk is copper-coated steel with hardened stainless steel wearing surfaces. Two dynamically loaded sealing rings of hardened stainless steel, backed up by synthetic rubber O-rings, are located on opposite sides of the disk at each port. The sealing force of these opposing rings against the faces of the valving disk is proportional to the service pressure. As pressure increases the seals become tighter. The sealing rings are self-compensating for wear, and seating improves with use, the

company says, adding that reversal of flow at any pressure, or even zero pressure, will not unseat these seals.

Body material is high precision cast aluminum alloy, anodized. The 90-deg turn handle has stops, with ball detents at both extremes for flow in either direction, and midway in the off position. It is available with spring centering device.

All bodies have side ports, tapped for 4-way closed center service. To obtain 2-way or 3-way service, standard pipe plugs can be inserted in ports not to be used. The unit is designed for panel mounting, $^1/_8$ in. maximum thickness. Sizes range from $^1/_8$ to 1 in. female pipe.

Flareless Tube Fitting

Weatherhead Co., Fort Wayne Div., 128 W. Washington Blvd., Fort Wayne, Ind., has designed and is now in production on a new type 7000 series Ermeto high-pressure SAE flareless, straight-thread hydraulic tube fitting. The fitting is an adaptation of the firm's design used in military, construction, and industrial equipment for hydraulic and pneumatic systems.

The new line meets the new standards as set by the SAE and is designed to accommodate minimum close coupling, positive seal and ease of assembly. The units have a new phosphate finish resistant to nonflammable hydraulic fluids as well as petroleum base fluids. Even without lubrication, the finish reduces torquing to preset or reset sleeve, the firm says.

Designed for use with the new SAE O-ring boss, this new line is said to withstand higher operating pressures without the use of backup rings; results in less O-ring distortion, longer O-ring life. The new type O-ring seal is also designed for air application and tested to operate at temperatures from −65 to 212 F.

Second Operation Machine

Desired spindle speeds are said to be capable of being achieved instantly by a touch of a button on the Model DSM59 second operation machine introduced by Hardinge Brothers, Inc., Elmira, N. Y.

Spindle speed changes for rates between 230 and 3500 rpm can be made without stopping the machine. The firm says the operator can locate the best speed for the most efficient chip removal and surface finish by simply pushing the "faster" or "slower" button found in a control box placed over the headstock. Simplicity in operating this high speed precision machine enables relatively inexperienced operators to turn out parts within close tolerance and fine finish on a production basis, the company says.

The unit makes it possible to chuck partially finished parts and rapidly do close tolerance turning, forming, boring, drilling, threading, and facing, with low cost tooling. Other features include a special collet closer. This lever operated ball-bearing collet closer permits opening or closing a collet or step chuck while the machine is in operation.

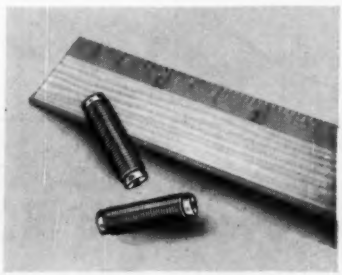
Production News from Bridgeport Thermostat

FROM THIS ALL-NEW PLANT—
MORE AND BETTER BELLOWS

On its new 15-acre site at Milford, Conn., Bridgeport Thermostat now has 180,000 square feet of automated production facilities to assure quick delivery of all the bellows you need . . . at the lowest possible cost. A temperature and humidity controlled room for charging bellows is only one of the many ways in which this ultra-modern plant promises you bellows of consistently high quality.

¼" DIAMETER BELLOWS

Progress at Bridgeport is typified by this tiny bellows for miniaturization. Available in seamless design with a wide range of characteristics in brass, phosphor bronze, beryllium copper and monel. Larger sizes available.



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CONTROLS COMPANY
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Please send me the following information: (Dept. LK-125)

☐ Full details on small-diameter bellows.
☐ Bellows Engineering Bulletin.

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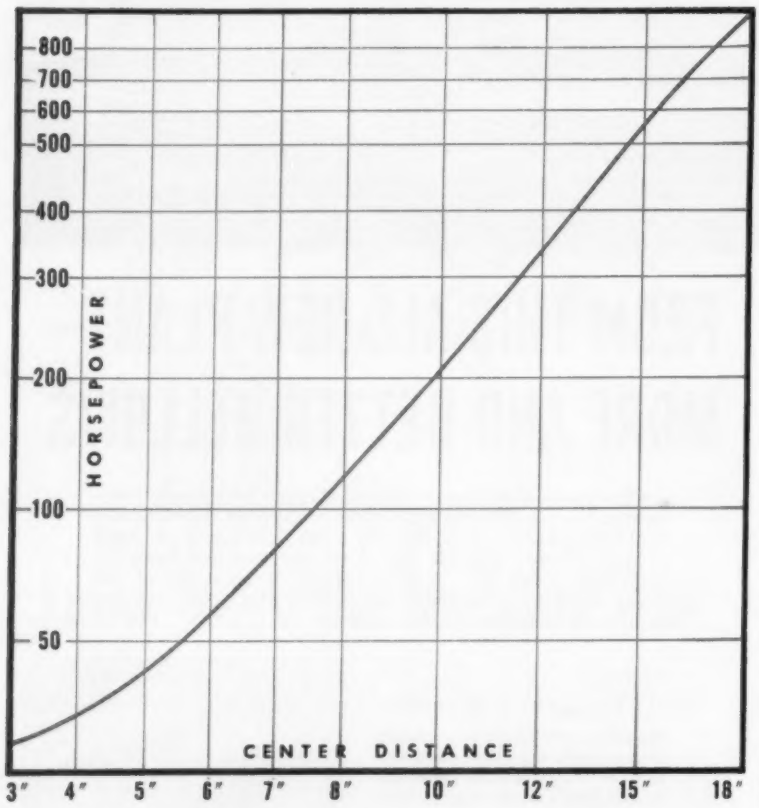

Prove the difference in worm gear speed reducers yourself. Here's how . . .

. . On this chart we've plotted the mechanical horsepower capacity of Cone-Drive worm gear speed reducers against their center distances. Ratings are for Class I Service with a 5:1 reduction and an input speed of 1750 rpm.

All you have to do is plot the corresponding ratings for the speed reducers you're now using or planning to use. We think you'll be surprised at the results.*

For details on Cone-Drive gearing's double-enveloping design and specifications, ask for Bulletin 600C. We'll send it to you immediately without obligation.

*If you're too busy to "Do-it-yourself", Cone-Drive representatives will be glad to show you filled-in charts.

CONE-DRIVE GEARS
Division Michigan Tool Company
DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS
7171 E. McNichols Road • Detroit 12, Michigan

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Hydraulic Control Valves

Multi-directional sectional hydraulic control valves for continuous duty at pressures as high as 2000 psi have been announced by Commercial Shearing & Stamping Co., Youngstown, Ohio. The firm says a major feature of the new line of valves is a positive "no load-drop" non-constricting check in each operating action section. Other features include greatly reduced resistance to flow through internal passages, sealing by O-rings instead of gaskets, and a unique cartridge-type relief valve.

The valves are available with 1/2, 3/4, or 1-in. work ports, with nominal capacities of 20, 35, or 60 gpm respectively. These valves will be performance rated enabling the prediction of actual pressure drop and capacity accurately for each section used in an assembly, under various operating conditions.

Constructed with solid, balanced spools, the valve operating action sections each have a built-in check, so that no pressurized return flow and therefore no load drop, can occur even if two or more sections are in operating position at the same time. Combined with a design permitting smooth throttling, this feature makes practical the operation of two or more valve sections simultaneously, the company states.

Chemical Tape

An improved pressure-sensitive Teflon tape said to defy the action of many reactive chemicals and temperature changes, is announced by Minnesota Mining and Mfg. Co., Dept. J6-61, St. Paul, Minn.

The new tape is said to combine the properties of a high-quality Teflon film with the chemical and heat resistant properties of a pressure-sensitive adhesive.

The tape, made in both a $3\frac{1}{2}$- and $6\frac{1}{2}$-mil thickness, consists of 2- and 5-mil films coated with $1\frac{1}{2}$-mils of silicone adhesive. The $3\frac{1}{2}$-mil tape features 200 per cent elongation and tensile strength of 25 lb per in. of tape width, while the $6\frac{1}{2}$-mil tape offers 150 per cent stretch and 40 lb tensile.

Continued on Page 55

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1	21	33	47	62R	73	84	102	115	129	143	154TL	IBC
2	22–23	34	48	63R	74T	85	103	117	131	144	154TR	OBC
3	24	35	49	64T	74B	87–88	105	118	132	145	154B	
4–5	25	36	50	65T	75T	91	106	121	133	146–47	155L	
6–7	26	37	51	65B	75B	93	107	122	134	148	155R	
8–9	27	39	52	67	76L	94	108	123	135	150	156	
10–11	28	41	55	69R	79	95	109	124	136	151	173BR	
12–13	29	42	56	70L	80	96	110	125	137	152L	175	
14–15	30	44	57	71	81	97	111	126	139–40	152R	177	
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4–5	25	36	50	65T	75T	91	106	121	133	146–47	155L	
6–7	26	37	51	65B	75B	93	107	122	134	148	155R	
8–9	27	39	52	67	76L	94	108	123	135	150	156	
10–11	28	41	55	69R	79	95	109	124	136	151	173BR	
12–13	29	42	56	70L	80	96	110	125	137	152L	175	
14–15	30	44	57	71	81	97	111	126	139–40	152R	177	
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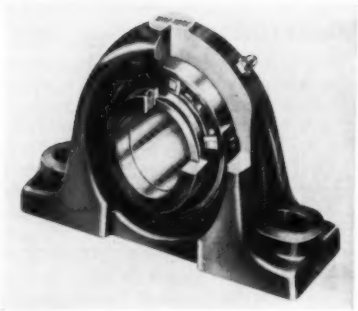

Positive-Seal Bearing

A new unit pillow block and a new unit flanged mounting for anti-friction bearings have been added to the firm's line of bearing mounts, according to an announcement by SKF Industries, Inc., Front St. and Erie Ave., Philadelphia 32, Pa.

Designated as Type SYH-X unit pillow block and Type FY-X unit flanged mounting, the new units are of the eccentric lock type. The SYH-X also has a reduced center height to permit its use where space is limited.

The new bearing mounts incorporate such special design features as positive sealing through the use of a duPont "Fairprene" washer to retain lubricant; an external rotating flinger to keep out dirt; a spherical outer ring to compensate for initial misalignment and a convenient re-lubrication fitting.

In place of the separate locking collar and set screws of the basic design, the SYH-X and FY-X are provided with eccentric locks for applications where this type of mounting is desired. The new units are available in the same load capacities as the SY and FY.

Both the FY and FY-X unit flanged mountings are suited for applications where pedestals are not available and the bearing housing must be mounted at right angles to the shaft, according to the company. Bolt holes on both types are spaced to allow the units to be interchangeable with mountings of similar design.

Bond Segments

V-40 bond segments, for grinding ferrous and nonferrous metals, have been developed by Carborundum Co., Niagara Falls, N. Y., and are now commercially available for immediate delivery.

The segments are said to be made of the highest grade of aluminum oxide abrasive grain in the variety of shapes used in all standard chucks. They have been specially designed for generating flat surfaces on plates, castings and machine parts and grinding machine knives.

According to the company, a new type of waterproof pad, applied to the segment with a special resilient cement, assures better holding power in the chuck. A recess in the end of the segment where the specification sticker is placed is provided for reference to size, grit, grade and bond.

Check the response-to-the-touch. You can actually feel the difference!

That's why the Paragon Drafting Machine noticeably cuts end-of-the-day fatigue . . . saves costly man hours . . . helps raise working standards.

See how easily protractor control ring can be reached—no matter what position your hand is in. Another time saver. Touch that ring with your *little* finger and scales rotate freely. Release pressure and scales automatically lock to nearest 15° position. And intermediate angles are just as easily set!

Top day-to-day performance is guaranteed by unique "open center" design of arms which protects smooth-working factory-set band tension.

A good look at a Paragon and a touch on that control ring is worth 1,000 words! Try it before you buy *any* drafting machine—you can *feel* the difference.

89 YEARS OF LEADERSHIP

In equipment and materials for drafting, surveying, reproduction and optical tooling . . . in slide rules and measuring tapes.

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At "Automatic" Sprinkler we've kept abreast of technological advancements and the effect of such progress in terms of fire safety for every business. In short, we either have the answer to your fire protection problem or our technicians will get it for you.

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Vibration Calibrator

A vibration calibrator designed to calibrate vibration pick-ups or to measure vibration of non-magnetic, metallic surfaces has been introduced by ACF Electronics, 800 N. Pitt St., Alexandria, Va.

The Model 501 calibrator utilizes a novel method of self calibration whereby vibratory displacements are compared with a precise standard displacement, the company says. It points out that the probe requires no direct contact with the vibrating surface.

The calibrator measures vibration amplitude over four decade scale ranges from 20 microinches to .02 in. full scale. On all ranges readings are independent of frequency from 10 to 20,000 cycles per second. Accuracy is better than 5 per cent of full scale in the measurement of sinusoidal or non-sinusoidal wave forms. For direct observation of wave form, signals from the output terminals of the calibrator can be connected to a conventional cathode ray oscilloscope.

The unit utilizes the characteristics of a mutual inductance transducer to achieve the range and accuracy of calibration. A probe containing the transducer excited by a high frequency signal is placed proximate to the vibrating surface. The variations in spacing between the probe and the surface cause a variation of mutual inductance in the transducer. After suitable detection and amplification, the variations are represented accurately as displacements on the meter of the calibrator.

Hydraulic Directional Valves

An improved line of solenoid operated and solenoid controlled, pilot operated directional valves for industrial oil-hydraulic systems is now available from Vickers Inc., Detroit 32, Mich. The firm says ample room is provided in the valve body for making electrical connections, thereby eliminating the need for a separate conduit box.

The new valves are improved models of the firm's DG series. Available for gasket or sub-plate mounting, they are compact and require a minimum of piping. Mounting dimensions remain unchanged.

Other new features of the valves are an override plunger and a solenoid cover chain. The override plunger permits manual operation of the valve during setup operations, circuit checks or solenoid or current failure. The chain prevents loss of covers during solenoid maintenance or adjustment.

Solenoid controlled, pilot operated valves in the new series are known as the DG-5 models. This type incorporates a solenoid operated pilot valve and a directional valve in a sandwich type unit. Many valving modifications are available. The DG-5 valves are available as four-way units for $^{3}/_{4}$-and $1^{1}/_{4}$-in. nominal and piping sizes. They can be obtained as single-solenoid spring-offset models or with a double-solenoid no spring or spring-centered design. Spool types may be open, closed, tandem center, or other combinations and modifications.

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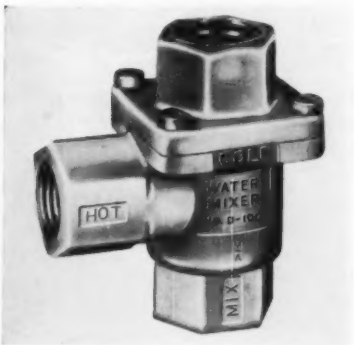
Self-Balancing Scale

Two to four seconds is said to be the normal weighing time with an automatic self-balancing scale being introduced by Arthur S. La Pine & Co., 6001 S. Knox Ave., Chicago 29, Ill.

The weight can be read to 1 gram or $^1/_{500}$ lb directly on the indicating dial without taking time to balance loose weights and beam poises. High-speed weighing is furthered by an adjustable hydraulic damper which brings the indicator to rest in $2^1/_2$ oscillations.

The dial reads weight to 500 grams or 1.1 lb. The total capacity of 5000 grams or 11.1 lb is attained with a poise sliding on a notched beam. Scale sensitivity is $^1/_4$ gram, and accuracy is $^1/_{100}$ of 1 per cent of full scale. The scale is readable in both metric and avoirdupois units.

The sliding weight on the beam can be employed as a tare by placing a container on the platform and moving the weight until the indicator returns to zero.

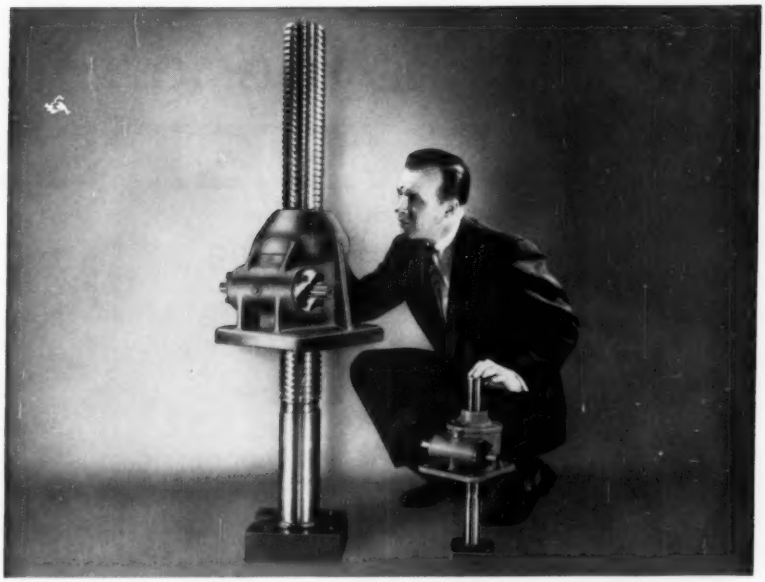


New Water Mixer

A new low cost water mixer designed for blending hot water with cold water to produce 140 F. final temperature was introduced recently by Bell & Gossett Co., Morton Grove, Ill.

Called the D-100 water mixer, the new valve is factory set to deliver water at 140 F and is not adjustable in the field. The body is of heavy forged brass and all tappings are $^1/_2$ in. IPS. A solid type of thermostatic expansion element is used and all working parts are noncorrosive.

The water mixer is said by the company to be ideal on all types of direct fired, or indirect type, water heaters where it is necessary to prevent excessively hot water from reaching the fixtures. A water mixer will also increase heater capacity by preventing too rapid a draw on the available hot water supply. The unit can be effectively used to obtain two different water temperatures from a single water heater. The 140 F water from the mixer will supply water for shower and faucet needs, while higher temperature water directly from the heater can be used for dish washing and laundry requirements.



Here's A Device Every Machinery Designer Should Know About . . .

It's the Duff-Norton Worm Gear Jack, successfully used by many machine builders as a component of equipment for precise, positive control of linear motion, applying pressure, resisting impact. Two or more of these jacks can be connected by means of shafting and mitre gear boxes to give a positive drive, so that jacks always raise or lower under equal or unequal loads in perfect unison. Capacities range from 5 to 50 tons with any raise up to 25 inches; worm gear ratios, 8:1 to 96:1; turn of worm for each 1-inch raise, 10 to 180; available in either Acme or square threads. For protection against foreign matter certain models can be furnished with bellows boots.

Thousands of these jacks are in use today for table adjusting—machine adjusting—rolling mill adjusting—raising and lowering conveyors, machine beds, molds and dies, furnace lids, loading platforms, loading racks, gates, hinged mechanisms, arbor presses—adjusting electrodes—overhead crane servicing.

Duff-Norton Worm Gear Jacks are available in 6 standard sizes. For complete specifications and detailed drawings, send for your free copy of a special brochure.

DUFF-NORTON Company

DUFF-NORTON CO.
Department ME
P.O. Box 1889, Pittsburgh 30, Pa.

Please send immediately a free copy of your new Worm Gear Jack Brochure.

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Design packaging for unitized and miniaturized assemblies and printed wiring.

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IBM leadership is based on a record of solid achievement and growth. During 1955, IBM announced a major data processing improvement on the average of *every two weeks*. IBM Engineering Laboratory personnel increased five-fold in the past five years!

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KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

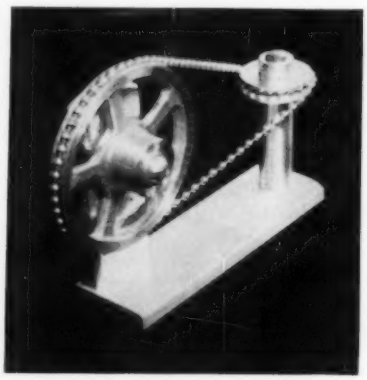
Capacitor Motors

Three new motors—two rated at 10 hp and one at 15 hp—have been engineered by Robbins & Myers, Inc., and added to its full line of all-weather, capacitor single phase motors.

Full-scale production of the new models, which are completely protected against the weather, debris and small field animals, is underway at the firm's Motor Div., Springfield, Ohio.

The new high torque, capacitor-start capacitor-run motors are available in 1725 and 1140 rpm speeds. The company says the motors are especially suited for use in the oil country, farm equipment manufacture and small industry as well as on farms, in applications requiring more than $7\frac{1}{2}$ hp on single phase operation.

The new motors have rodent-proof housing, external mounting of condensers and centrifugal switch mechanism in weatherproof covers, and rust-inhibited rotors, shaft and fan.



Bead Belt Drive

A new method of providing positive synchronous drive without gearing, known as bead belt drives, has been introduced by Voland and Sons, 32 Relyea Place, New Rochelle, N. Y.

The firm says that many design problems where the transmission of motion between elements might hitherto have indicated the need for intricate gear systems or other expensive or complicated mechanisms can now be solved pensively by the use of the bead belt drives. In one typical problem, four bead belt drive sprockets and a loop of bead chain actually replaced eight gears, bearings, and supports.

Drives consist of bead chain and sprockets which provide positive synchronous drives with the flexibility of installation usually associated with belts. Considerable misalignment between shafts can be tolerated, permitting a wide variety of configurations without resort to bevel gears, universal joints, or other devices ordinarily required to transmit motion between remote or inaccessible locations, the company says.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Lubricating Systems

Centralized lubricating systems designed to withstand temperatures up to 500 F while providing fully automatic lubrication are announced by Bijur Lubricating Corp., 151 W. Passaic St., Rochelle Park, N. J.

The systems use newly designed valves and filters that combine heat-resistant qualities with desired filter and flow control characteristics, the company reports. The firm has also worked with several major oil suppliers who developed special lubricants to be used in conjunction with the new systems.

High temperature lubrication equipment has been successfully installed on different types of machinery operating under temperatures ranging from 200–500 F, such as hot cut flare machines for the glass industry, flatwork ironers in commercial laundries, and valve stems of large industrial gas engines. The company reports that the new systems are also applicable to many machines in the food processing, chemical processing, baking and related industries.

High temperature units are available in most of the company's extensive line cyclic, continuous and one shot centralized lubricators.

The new systems are made up of three basic components: a combination pump-reservoir that feeds oil at a predetermined frequency and volume into a single-line distribution system, with junctions and branch lines leading to each lubricating point where a meter-unit filters and measures the oil and maintains one-direction oil flow.

In this overall system, the company says, there are two key points where high temperatures present a problem: at the inlet on the lubricator itself, where oil is drawn from the reservoir into the pump; and at the individual meter-units, each of which contains a filter and a check valve.

The firm uses a sintered bronze filter material to withstand high temperatures while providing effective filtering action. These porous bronze filters have a density equivalent to an SAE F-10 felt filter, and are used in both the lubricators and meter-units.

Absolute Pressure Transmitter

An absolute pressure transmitter, which will measure pressures in ranges as low as 0 to 5 mm mercury absolute, and transmit the measurement as a 3–15 psi pneumatic signal to an automatic controller or receiver, has been announced by Bristol Co., Waterbury 20, Conn.

The Metagraphic absolute pressure transmitter is offered to handle pressure ranges from 0–5 mm Hg to 0–760 mm Hg. It transmits a universal 3–15 psi pneumatic signal, and can be used with any standard pneumatic receiver or automatic controller the firm states.

A full line of such indicating and recording receivers and automatic controllers are also offered in the Metagraphic line.

CREATIVE
ENGINEERS
WANTED
to explore
new frontiers
Just as interesting and challenging as the geographical frontiers of 150 years ago are the scientific frontiers of today. Some of the most fascinating must be penetrated in order to develop a practical nuclear engine for aircraft.
Pratt & Whitney Aircraft, world's foremost designer and builder of aircraft engines, began its work on a reactor-powered aircraft engine some time ago. The unexplored areas are vast, however, with many relatively unknown. To map them, still more adventurous young engineers and scientists are needed.
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U.S. DISASTER MAP

You help others—you help yourself— when you join your Red Cross

There are 317 crosses on this map. Each marks a Red Cross Chapter where disaster struck suddenly in 1953-1954 and where the Red Cross working with local organizations gave relief to disaster sufferers.

What will the Disaster Map for 1955 look like? Will there be fewer crosses? Or more? No one knows. But one thing is certain: Year in and year out, on the average, your Red Cross working with other local agencies gives relief in 6 disaster calls a week somewhere in the U.S.A.

When It Happens No One Is Alone...

You will be there—because your Red Cross will be there!

That is the Red Cross way when disaster strikes; when blood or first aid save a life; when a serviceman or his family needs a helping hand.

If you believe that no one should be alone in time of trouble—that no one should be alone in giving help—you will join your Red Cross and support it generously.

ANSWER THE CALL! JOIN YOUR RED CROSS!

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Reduced Dimension Locknut

A new high strength, washer face hex nut for minimum wrench clearance applications has been designed by the Elastic Stop Nut Corp., of America, Union, N. J.

The new Type TEE2032 was developed for the Kiekhaefer Corp., manufacturers of outboard motors, as a connecting rod cap bolt nut. The company says basic problems of providing high strength and limited wrenching space were solved by reducing the hex size and selecting high strength material. The height of the nut was increased to .239 and the width across the flats reduced to .375. This design, the firm says, also provided the maximum wrenching surface at a minimum of nut base area with the over-all dimensions of the 1/4—28 Type TEE2032 reduced to that of a 10—32 nut. Regardless of size these self-locking nuts provide a load bearing capacity almost 20 per cent greater than standard 1/4—28 nuts. The axial tensile strength reaches 5379 lb minimum.

The red nylon collar in the head of the nut provides the positive self-locking feature which holds the nut firmly in place in spite of severe vibration. Manufactured of C-1137 steel, plain finish the nut is available in 1/4—28 thread size.

Flat-Type Motor

A flat-type motor in totally-enclosed fan-cooled or totally-enclosed non-ventilated designs, is announced by Diehl Mfg. Co., Somerville, N. J.

Designed to meet the specifications for NEMA design "B" motors, the new motor was developed for use in the machine tool and equipment industries for operating turret lathes, punch presses, milling machines, pumps, oil burners, exhaust system and similar applications where there is a minimum of space.

Weighing considerably less than standard motors, the units are of standard radial design, constructed like conventional squirrel cage motors. The firm says there are no precision alignments or complicated air-gap adjustments with which to contend. The rotor weight is evenly supported between two ball bearings.

Operating at 208, 220/240 or 550 volts, 2 or 3 phase at 60 cycles, continuous or intermittent duty, the motors are available in ratings ranging from 1/3 to 7 1/2 hp.

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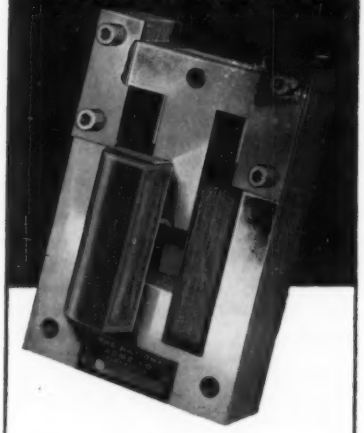
SOLENOIDS
WITH ARMORED CONTACT POINTS
For Millions Of Dependable Operations



Standard... or Custom Engineered

National Acme Solenoids will make your job easier—because they do their job better!

1. Made in Push and Pull types—within sizes ranging from 2½ to 21 lbs. at ½-inch stroke—to 2 to 25 lbs. at 1-inch stroke.
2. Rugged enough for the heaviest type of duty.
3. Compact—especially suited for limited space service.
4. Non-magnetic retainers.
5. Available with terminal blocks and variety of standard mountings.

Send for complete details in BULLETIN EM-52—or discuss your design problem with our representative.

Electrical Manufacturing Division
National Acme
The National Acme Company
192 East 131st Street, Cleveland 8, Ohio

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Rotating Grate Magnet

Eriez Mfg. Co., Erie 6, Pa., announces production of a unique permanent magnetic rotating cylindrical grate, to be known as the Rota-Grate, designed for installation at the discharge of open or enclosed chutes, or in open or closed duct systems, for magnetically removing pieces of tramp iron while also preventing clogging or bridging of material.

The patented magnetic separator is said to be efficient in separating any kind of iron contamination from finely grown cohesive materials such as gypsum, barium carbonate, fullers earth, lime, cohesive chemicals, confectionery sugar, corn starch, flour, wood flour and fiberous materials like chopped hay, alfalfa and flax.

The grate is composed of multiple stainless steel Alnico V tube magnets mounted horizontally between stainless steel plates. The entire assembly rotates around a central shaft which extends beyond the end-plates sufficiently to accommodate a drive pulley and permit installing the unit in flange or pillowblock type bearings.

In operation, the unit revolves through the flow of material at a predetermined speed related to the nature and condition of the material being processed. Under excessive choke conditions, the company says, the grate will deliver optimum magnetic separation at 5–10 rpm. A top speed of 30 rpm will generally not be exceeded; and for best results under average conditions, a speed of 15–20 rpm is recommended by the company.

The grate is available in standard diameters of 12, 16, and 22 in. these being composed of 10, 15, and 20 magnetic tubes respectively, and in widths beginning at 4, 8 and 12 in. respectively and continuing, through 4 in. increments, to a maximum standard width of 36 in. for all diameters.

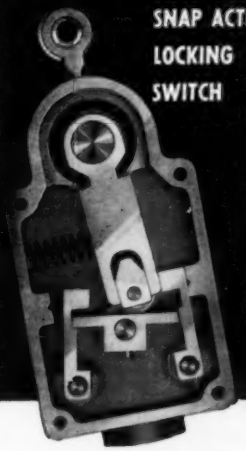
Interpolation Oscillator

Hewlett-Packard Co., 275 Page Mill Rd., Palo Alto, Calif., announces its Model 200J interpolation oscillator, designed for measurements where frequencies must be known with extreme accuracy.

A 6-in. tuning dial, in combination with six ranges, results in an 80-in. scale length. Calibration accuracy is ±1 per cent over the frequency range from 6 cps to 6 kc. The instrument provides an output of 160 mw or 10 v into 600 ohms, or 20 v open circuit. The output is balanced to ground. Distortion is less than ½ of 1 per cent. Frequency stability is ±2 per cent or .2 cps and the frequency response is less than ±1 db for the full range.

The unit incorporates the firm's resistance-capacity oscillator circuit. It is equipped with electrolytic condensers, surface treated insulators, inspected transformers, and a precision mechanical drive designed to assure ease of operation and minimum maintenance requirements. The instrument is mounted in a sturdy, lightweight portable metal case with carrying strap.

NATIONAL ACME
SNAP-LOCK
TRADE MARK
THE ORIGINAL
SNAP ACTION LOCKING SWITCH



All National Acme Switches—Limit, Push Button, or Motor Starter Switches employ the same dependable, basic, SNAP-LOCK design. As illustrated above, the snap-action locking mechanism is simple, fool-proof and long-lived. Self-wiping, coin-silver contacts insure quick action make and break—with maximum wear resistance. For AC or DC service.

Electrical and mechanical sides are separated by a wall within a sturdy die-cast housing which is fully insulated, and is oil and dust resistant. Can be furnished water and oil-tight.

Limit Switches
Made in both single-pole and double-pole series, and with a wide variety of standard operating levers. Also made in push-lever type and with explosion-resistant housing.

Push Button
Made in heavy-duty, flush or surface-mounted types.

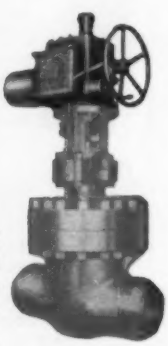
Motor Starter
Designed for 3-phase motors to 7½ HP on AC; ½ HP on DC.

FOR COMPLETE DETAILS send for Bulletin EM-51

Electrical Manufacturing Division
National Acme
THE NATIONAL ACME COMPANY
192 East 131st Street, Cleveland 8, Ohio

Check these features

- Micrometer torque seating switch gives tight valve closure, and protects valve parts from damage.
- Self contained unit—no gears, stem nut or bearings to buy.
- Weatherproof, dust-tight, watertight and explosion-proof construction.
- Hammerblow device . . allows motor to reach full speed, before load is engaged.
- Non-rotating handwheel built into the unit.
- Automatic declutching.
- Motor is disengaged during handwheel operation.
- Can always be declutched for handwheel operation regardless of weather or electrical conditions.
- High torque motors.
- Simple valve yoke.
- May be mounted in any position.
- Three to four times faster handwheel operation.
- Actuation may be by any available power source such as electricity, air, oil, gas, water or steam. LimiTorque is readily adapted for microwave control.
- LimiTorque is designed for plug, butterfly, gate and globe valves up to 96" diameter . . . Entire Unit and nut can be lifted off valve yoke, by removing flange bolts.



Send for Catalog L-550 and see why this and other types of LimiTorque Valve Operators are so widely used.

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KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Automatic Boiler

Orr & Sembower, Inc., Reading, Pa., has introduced a compact, packaged automatic low-pressure boiler for oil and gas firing.

The new Power-Pak is designed to provide steam or hot water heating or hot water service with power demands of 10, 15, 20 and 25 hp. It is designed for such applications as smaller schools, office buildings, apartments, greenhouses, hospitals, and churches, and auxiliary use in large industrial plants and warehouses.

It is the only unit of its type and capacity that meets standards of 5 sq ft of heating surface (ASME) per boiler horsepower throughout its full range, the company claims.

Piston Seal

A special type of piston seal has been developed for applications where flange parting surfaces must form a metal to metal joint. Called a "Class 3 Bellofram," the new seal is one of four distinct types of long stroke, deep convolution, constant area diaphragms which simplify both design and manufacture of pressure sealed mechanisms. It is manufactured by Bellofram Corp., Burlington, Mass.

In design, the new Seal employs a flange with a clamping bead on its lower surface. The company says typical uses of a metal to metal flange contact include cases where through bolting would exert excessive forces on the flange, causing extrusion; where flange perforation and positioning over stud or tap holes would be awkward; or where uneven clamping forces result in an undesirable non-parallel condition between the cylinder and its mating part.

The units are available in more than 80 standard sizes, for bores from 1 to 6 in. in diameter. Elastomer-fabric combinations range from nitrile rubber and nylon to silicone rubber and Dacron.

Unicellular Rubber Floats

Floats of hard unicellular rubber sponge, fabricated to customer specification, are now being produced by Rubber Products Div., Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.

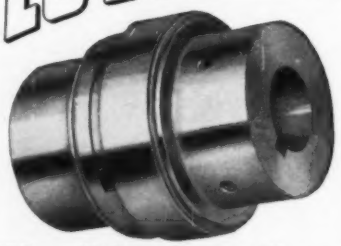
The firm says the new material of minute sealed-cell structure is lighter than cork, will withstand higher temperatures, is resistant to fungus growth, needs no protective coating, maintains stable weight and volume and is not subject to becoming "waterlogged." In contrast to metal floats, the new material will not fall due to vibration conditions or from puncture, the company points out. It can be drilled or otherwise machined and can be molded to shape with or without metal mounting arm. It has a specific gravity of .14.

Testing indicates the material is suitable for use in water, oil, gasoline including aviation fuels, and various other liquids, over a wide temperature range, the firm states.

15 YEARS SERVICE WITH ONE SET OF CUSHIONS

. . . actual report on

LOVEJOY



Flexible Couplings

Up to fifteen years maintenance-free service is not unusual with Lovejoy lubrication-free flexible couplings.

Performance like this is practical proof of these soundly engineered features:

SIMPLE, RUGGED CONSTRUCTION
Fewer parts. No intricate mechanisms. Nothing to lubricate.

LOAD TRANSMITTED BY CUSHION COMPRESSION
No wear on the metal jaws.

DOUBLE-LIFE CUSHIONS
One half of the cushions act as idlers—except on reversible loads. A quick interchange provides a new set of cushions. This can be done without dismantling the coupling.

Illustration at right shows a Lovejoy Type CF flange-mounted coupling. Rated at 160 hp., 800 rpm., this space saver connects drive shaft between diesel power unit and generator.

You can get Lovejoy performance for your application.

Let us know your requirements or request complete-line catalog.

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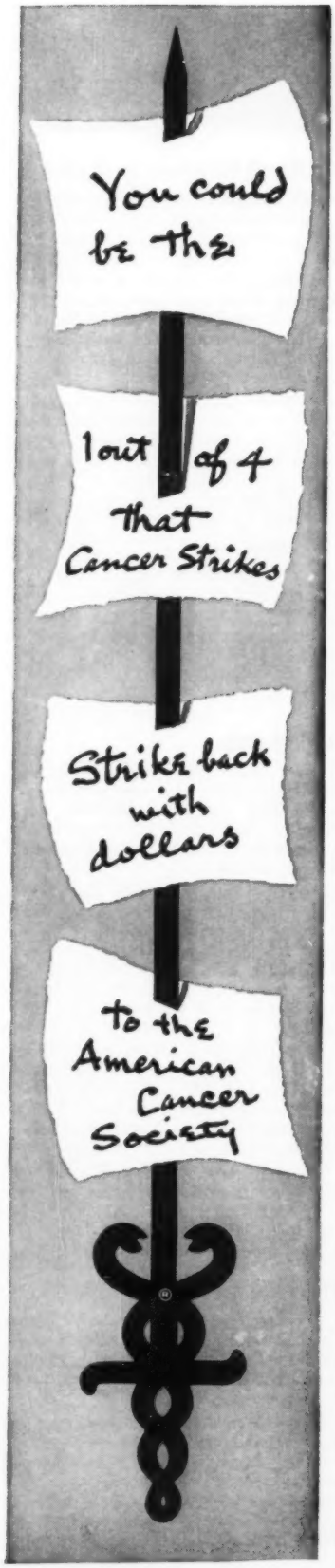
4832 W. LAKE STREET • CHICAGO 44, ILLINOIS

Mfrs. of Flexible Couplings, Variable Speed Pulleys and Transmissions, Motor Bases and Universal Joints.



KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Air Cushion

A transfer plate and a heavy die with a combined weight of 1000 lb is said to float like a feather on a thin cushion of air in the heavy press department of Northrop Aircraft, Inc., 1001 E. Broadway, Hawthorne, Calif., due to an application of the pneumatic principle, developed by the firm's tooling engineers.

Six evenly spaced 1/8 in. holes inject compressed air at 100 psi against a hydropress table to lift the heavy tooling plate and die. Operators can then move the die under the press with ease.

Only five lb pressure is necessary to move the plate and die when the air is turned on. Five men would be required to move the apparatus without use of the pneumatic device, the firm says.

Aluminum Oxide Cement

A new aluminum oxide cement has been developed by Electro Refractories & Abrasives Corp., Buffalo, N. Y. to provide a more heat-resistant, longer-lasting lining for indirect arc-type electric furnaces.

The aluminum oxide is said to hold up much better under high temperatures and slag attack than the mullite-base cements commonly used in these furnaces for melting ferrous and non-ferrous alloys. The linings weigh from 500 to 1000 lb. The material can also be used for patching existing furnace linings.

Known as Kellundite No. 8, the new cement is one of several being developed for furnaces in steel and brass foundries.

Digital Supervisory Control

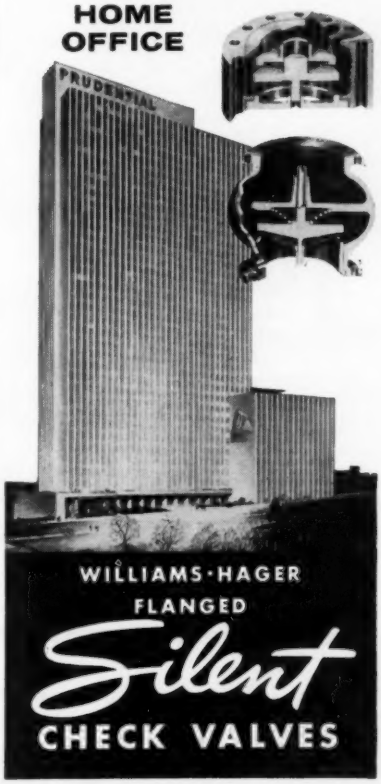
A remote tank gaging system is now being produced by Pacific Div., Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif. The equipment is designed for applications in petroleum and process industries.

The simplified system remotely measures liquid levels in tank farms of any size over a single wire-pair of any length leading to the tank farm area, the firm states. The operator of the tank gage receiver selects the tank he wishes to measure, causing the selected tank to begin automatically to transmit data. The tank number then lights up in a group of lamp registers on the left of the panel. Almost instantly following this, in light register groups to the right, a reading of the liquid level in the tank in feet, inches and fractions of an inch will appear.

The system will read liquid levels to 64 ft in 1/8 in. increments. It will read and hold or scan tank farms automatically. Average temperature can be determined and transmitted with the liquid level information. Cyclic timers can be used, also, to make readings at pre-selected times.

Coding is such that recorded readings may be made into an electric typewriter or on punched cards.

SAFE, *Silent* PIPING for PRUDENTIAL'S MID-AMERICA HOME OFFICE



WILLIAMS·HAGER FLANGED *Silent* CHECK VALVES

OTHER REPRESENTATIVE BUILDINGS:

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Empire State Building, New York, N. Y.
Hotel Conrad Hilton, Chicago, Ill.
Merchandise Mart, Chicago, Ill.
Pentagon Building, Washington, D. C.
Hotel Statler, Los Angeles, Calif.
Rockefeller Center Buildings, New York, N. Y.
Standard Oil Building, Chicago, Ill.

Water hammer is effectively controlled by Williams-Hager *Silent* Check Valves. Troublesome noises are eliminated, and piping, pumps and other components are protected from damage.

Write for Bulletins:
No. 654 on the Valves
No. 851 on Cause, Effect and Control of Water Hammer

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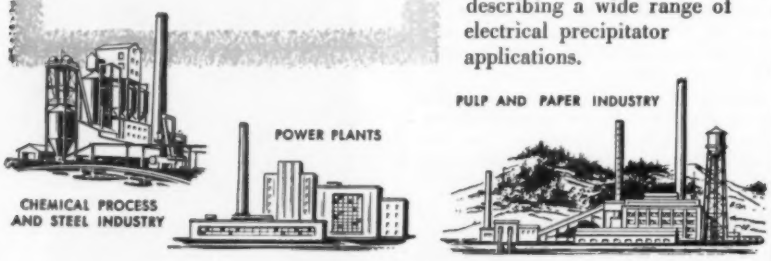
To maintain visually clean stacks at all times, industry is turning to the long experience of Research-Cottrell in the design and manufacture of highly efficient Cottrell Electrical Precipitators. We've spent 40 years in solving such problems as nuisance abatement, cleaning gas for subsequent use and recovering materials of value. Write for illustrated bulletin describing a wide range of electrical precipitator applications.



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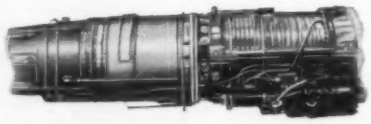
HYDRAULIC RESEARCH ENGINEERS

To Develop TEST FACILITIES for Jet Engine Fuel Control Systems and Components.

Working with: High Energy Fuels at Extremes of Temperatures and High Pressures



Test Stands

Environmental Test Cells

Remote Instrumentation

Servo Operated Afterburner Fuel Controls, Inlet Temperature and Turbine Speed Sensing Electro-Hydraulic Servo Controls.

Applicant should have B.S. Degree Plus 4-6 Years Experience Relative to Hydraulic Engineering, Valve Design, Hydraulic Servos, Instrumentation and Testing of Fluid Control Devices, or Other Associated Fields.—Write to Mr. J. Heffinger, Supervisor of Salaried Personnel

AC THE ELECTRONICS DIVISION

GENERAL MOTORS CORPORATION

MILWAUKEE 2, WISCONSIN also FLINT 2, MICHIGAN

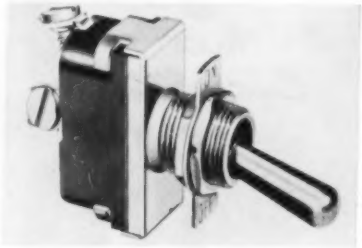
KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Snap Hearth Furnace

A new snap hearth furnace has been added to the line of standard furnaces manufactured by Surface Combustion Corp., Toledo 1, Ohio.

The new furnace is said to be the first suspended hearth type with radiant tube heating. It eliminates the old muffle with its maintenance and replacement problems, the firm claims, and suction type radiant tubes prevent contamination of prepared atmosphere.

The new furnace is described in a four-page two-color folder, Bulletin SC-173.



Toggle Switches

A new line of 15-amp single and two-circuit toggle switches is announced by the McGill Mfg. Co., Inc., Electrical Div., Valparaiso, Ind. Designed for a-c operation, models are available in three separate switching arrangements.

Model 90 is a single-pole single-throw switch designed for on-off operation. Model 91 is a two-circuit, single-pole, double-throw switch with a center "off" position. Model 92 is a two-circuit unit similar to Model 91, except that it throws directly from one circuit to another with no "off" position.

All are rated for $^3/_4$-hp capacity and for 15-amp service at 125 v, or 10 amp at 250 v. They have a molded phenolic case with exposed parts finished in bright nickel. Switching mechanism features heavy silver button contacts.

Switches are available with screw terminals, soldering lugs, or spade terminals to fit AMP 41202. Dimensions are: $^1/_2$ in. wide, $^1/_2$ in. thick, and $1^1/_8$-in. long. The $^{18}/_{32}$-32 threaded nipple is $^7/_{16}$ in. long.

Preformed Crucibles

Announcement has been made by United Carbon Products Co., Bay City, Mich., of the availability of preformed high purity graphite crucibles, boats and funnels for research and development.

The firm says its preformed crucibles, funnels and boats are used extensively in vacuum fusion analysis, manufacture of transistors, and in many special metallurgical studies and applications. Accurately machined to close tolerances, the units are being produced in a variety of standard sizes.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Hydramotor Valves

Availability of a new HO series of Hydramotor valves has been announced by General Controls Co., Glendale, Calif. Smaller in size and capacities than the standard H-1, H-2, H-3 series, the valves are said to be adaptable to the commercial and light industrial uses to provide on-off control with tight shut-off of gas, oil, liquids and steam.

The firm states the valves are suited for zone control in heating and air conditioning systems, and for hot and chilled water applications. The valves are said to provide for remote control in response to thermostats, limit or operating controls, remote switches or paralleling with motor driven burners, fans. The electric motor hydraulic actuator eliminates the need for reduction gears, is hermetically-sealed, and positioned in-line with the valve. Normally open or normally closed and three-way types operate against a heavy return spring, incorporating a two-wire circuit that automatically returns to de-energized position in event of current failure. Operating pressures up to 300 psi are obtainable, in iron or bronze body. The series is standard with spring loaded Teflon packing gland.

Miniature Anchor Nuts

For fastening applications where space allowables are reduced to a minimum and low weight is of paramount importance, a new line of miniature self-locking anchor nuts has been developed by Elastic Stop Nut Corp. of America, Union, N. J. The firm says the "Space Savers" meet the same tensile, vibration and temperature requirements as standard AN366 locknuts of similar configuration.

The new line was designed to provide a self-locking nut that would be dimensionally suitable for fastening applications in the constantly shrinking units developed by the electronic and avionic industries, the company states.

Present configurations include a two-lug anchor nut plate LHTA1M, a corner anchor LHTA5M, and a one-lug anchor LHTA17M. Anchor configurations are designed for applications where the nut is fixed to the basic structure to provide a blind fastener in inaccessible locations. The offset-crown, self-locking device is said to assure safe, repeated reuse during maintenance and repair.

Made of carbon steel, heat treated and cadmium plated, their weight is approximately one-third that of standard AN366 locknuts ranging from .10 lb per 100 in the 6-32 thread size to .27 lb per 100 in the 1/4-28 thread compared with .27 lb per 100 to .70 lb per 100 in standard locknut lines of the similar thread sizes.

The new line meets performance requirements of AN-N-10 for temperatures up to 500 F. The three configurations are available in four thread sizes: 6–32, 8–32, 10–32 and 1/4—28.

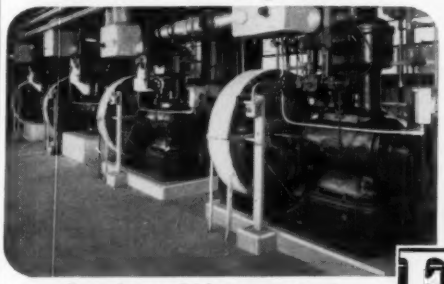
TRADE FRICK MARK®

Refrigeration

Serves Velsicol Chemical Corp. 3 Ways

At the Memphis plant of this important manufacturer of insecticides, Frick equipment performs these vital functions:

1. condenses chlorine gas to liquid form
2. cools water for chilling caustic
3. chills alcohols to 40 degrees below zero in an organic process.



Four of seven Frick compressors at Velsicol's Memphis plant.

Whether you need a cooling system for air conditioning, food service, ice making, quick freezing, chemical processes or any other commercial or industrial purpose, you'll find Frick ENGINEERED refrigeration the ultimate answer. Let us serve you as we now serve the biggest concerns in the world.

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA. U.S.A.

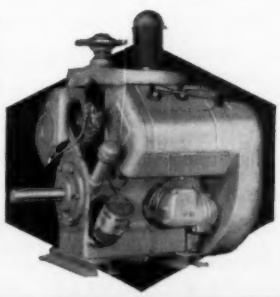
The tiny ant has strength and stamina far out of proportion to its size . . .

HEAVY-DUTY ENGINE POWER can be packed into small space, too . . .

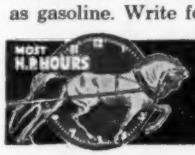
WISCONSIN HEAVY-DUTY Air-Cooled ENGINES

Like the tiny ant, Wisconsin scientifically engineered and constructed engines more than hold their own with power units of greater bulk . . . both in terms of usable horsepower and heavy-duty stamina.

The basic high torque design of these compact engines, combined with an accurate and sensitive governor, enables the engine to *pull through* when subjected to sudden heavy loads. It *hangs on* and *carries on!*



Wisconsin Heavy-Duty Air-Cooled Engines are available in twelve different sizes, in a complete power range from 3 to 36 hp. All models can be equipped with electric starter and generator (or starter only) and can be adapted to operation with kerosene, natural gas and LP fuels, as well as gasoline. Write for Bulletin S-188.



WISCONSIN MOTOR CORPORATION

World's Largest Builders of Heavy-Duty Air-Cooled Engines

MILWAUKEE 46, WISCONSIN

what every engineer should know

about the future at MARTIN

No other industry—and few companies—can offer more exciting futures than are now available at Martin in the fields of aircraft, missiles, rocketry, nuclear power and space vehicle development.

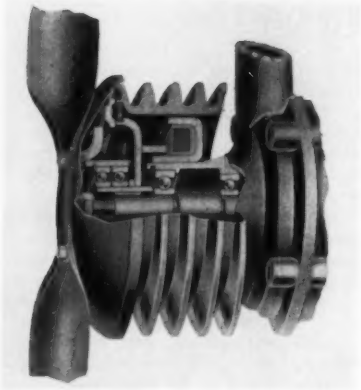
No previous experience is necessary to enter this horizonless new world of creative engineering. But the time to act is NOW. There may never again be such a need and such challenging opportunities in this industry.

If you are interested in a future that is literally "out of this world," you'd do well to investigate the Martin story. It's a story of one of the youngest and most dynamic engineering teams in the aircraft industry today.

Contact J. M. Hollyday, Dept. ME-06, The Martin Company, Baltimore 3, Maryland.

MARTIN

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS



Fan Clutch Unit

Warner Electric Brake & Clutch Co., Beloit, Wis., has announced the development of a new low-cost electric fan clutch unit for internal combustion engines. Applications include automobiles, trucks and busses, tractors and farm implements, construction equipment, marine applications and amphibious vehicles, and portable power units.

Operation of the unit is said to be relatively simple and it may be adapted to engines which carry the fan and water pump on the same shaft driven by a common pulley, or to engines on which the fan is separate from the water pump.

A typical application shown in the illustration utilizes an electric clutch of stationary-field design. In this installation, the field is mounted on the water pump housing. The sheave and rotor are fastened together and mounted in such a way as to drive the shaft continuously. In this way the water pump impeller rotates constantly.

A hub is mounted on bearings in front of the rotor with an armature fixed to the hub with leaf springs so that it runs normally with a small clearance between its face and the rotor face. The fan is bolted to the front of the hub. When the coil is energized, magnetic pull at the rotor pole faces attracts the armature and holds it to the rotating rotor. The hub and fan are then driven with the pulley.

This clutch is generally set up so that a thermostatic switch may be used to control it. The thermostat is located so it can be actuated by a change in temperature of the water system in order to cycle the fan clutch on and off as required.

The company says tests have indicated that on days when the outside temperature is below 50 F, the fan is not needed even for slow city driving. Highway tests at an average speed of 40 mph show that when the outside temperature is above 90 F, the fan engages only about 40 per cent of the time.

For Consulting Engineers Turn to Page 176

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Small Control Valves

Uniflow Valve Corp., 19 Quine St., Cranford, N. J. announces the release of its small flow air operated Saunders patent type control valve. It has a springless motor, is in sizes of $^1/_2$ and $^3/_4$ in. and has an overall height of 6 in.

Bodies can be furnished screwed or flanged in the following materials: cast iron, stainless steel, rubber lined, glass lined, Hastelloy C. The valves are designed for use in research laboratories, pilot plants and other industries that require corrosion resistant valves for controlling very high vacuum. Top mounted Moore valve positioners can be supplied for throttling control.

Diesel Compressors

Atlas Copco Pacific Inc., 930 Brittan Ave., San Carlos, Calif., has announced broadening of its line to include the full range of Series AR compressors. Previously, this supplier of Swedish-made equipment focused its activities on smaller size and portable compressors.

The heavy-duty AR series is said to be especially adapted to foundry and manufacturing plant installations, providing air for the operation of grinders, hoists, chucks, drills and other pneumatic tools, jigs and fixtures.

It includes six models, ranging in size from 330 to 3,220 cfm. All are of the L-shaped, two-stage, double-acting type compressor, fully counter-balanced. Units to 800 cfm are available steel skid-mounted, to permit moving the compressor to other job sites within the plant.

Relatively low operating speeds are claimed to be the stand-out feature of models. Longer valve life and less operating heat are among the reported accrual advantages; as well as a power requirement to drive, said to be approximately 5 per cent less than that of comparable size compressors. Standard type synchronous or induction motors may be used as the drive source.

Other construction features include annular type valves and double-row spherical roller bearings in the crackshaft journals.

Adjustable Speed Drive

Dynamatic Div., Eaton Mfg. Co., Kenosha, Wis., announces that it has developed and can now supply adjustable speed, fractional horsepower, Ajusto-Spede drives with integral electrically operated fail-safe friction brakes.

The brakes are available in two ratings—18 and 36 lb in. of torque. The small single package drive is an integral combination of a-c constant speed induction motor, eddy-current coupling, friction brake and electronic control. A simple connection to a standard power line is the only wiring required. All drives have a continuous constant torque rating through a 25:1 speed range. Electronic control insures speed stability of ±2 per cent of top speed at any point within the operating range.

R/M VEE-FLEX®

is America's most copied packing...

BECAUSE **it is designed for practically every piston and rod**

BECAUSE **it can be supplied with rock-hard adaptor rings**

BECAUSE **it has polymer-saturated fabric**

BECAUSE **it has precision trimming**

BECAUSE **it has proper interference for automatic sealing**

No matter what your hydraulic application, you will get better sealing with R M Vee-Flex. The background of this packing is top-flight design engineering combined with superior molding techniques. The result is a self-sealing, self-adjusting packing that will always give you a perfect seal—even at pressures in excess of 6000 psi.

R/M MAKES A COMPLETE LINE OF MECHANICAL PACKINGS

R/M's line of molded hydraulic and pneumatic packings includes:

VEE-FLEX PACKINGS
VEE-SQUARE PACKINGS
HOMOGENEOUS VEE-RINGS
FABRIC PISTON CUPS

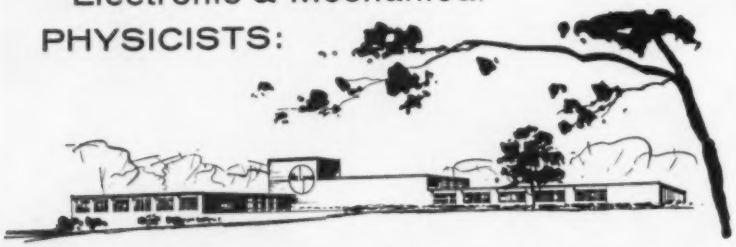
For complete information, send for booklet

RM PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; Passaic, N.J.; Neenah, Wis.; No. Charleston, S.C.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Packings • Asbestos Textiles • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Laundry Pads and Covers • Bowling Balls

ENGINEERS,
Electronic & Mechanical
PHYSICISTS:



Top Grade Openings

At Melpar *Leader in*

Electronic Research & Development

Due to our continuing expansion program, a number of top grade openings exist in our new laboratories suburban to Washington, D.C. We urge you to consider the following:

1. At Melpar the engineer is not tied to a pre-arranged schedule of advancement. Instead, promotion and advancement are based on *individual recognition*, where skill and ability are the paramount factors of determination.

2. Melpar has doubled in size every 18 months for the past 10 years. New openings occur constantly. This enables the engineer to advance to positions of increased responsibility *as soon as he is ready*.

3. Our unique "project team" basis of organization gives the engineer an opportunity to participate in *entire* problems from conception to completion of prototype, and thus experience the "over-all" approach to engineering problems necessary to eventual directorship responsibility.

4. Our new air-conditioned laboratories encompass over 285,000 square feet and offer *complete* facilities for creative research and design. In addition to our central Model Shop, supplementary facilities, personnel and test equipment are available for *immediate* use within each project group.

5. The Northern Virginia Area, suburban to Washington, D. C., in which Melpar is located, offers excellent living conditions, enjoys the Nation's highest per capita income, fine homes and schools. Recreational, cultural and educational facilities abound. Fully-accredited graduate courses are offered at the Melpar laboratories and at 5 universities in the Area.

Top Grade Openings Exist in These Fields:

Network Theory • Systems Evaluation • Microwave Technique • UHF, VHF, or SHF Receivers • Analog Computers • Magnetic Tape Handling • Digital Computers • Radar and Countermeasures • Packaging Electronic Equipment • Pulse Circuitry • Microwave Filters • Flight Simulators • Servomechanisms • Subminiaturization • Electro-Mechanical Design • Small Mechanisms • Quality Control and Test Engineering

Write for complete information. Qualified engineers and physicists will be invited to visit Melpar at Company expense.

Write: Technical Personnel Representative

MELPAR *Incorporated*

A Subsidiary of Westinghouse Air Brake Company

3092 Arlington Boulevard, Falls Church, Virginia

Positions also available at our laboratories in: Cambridge, Mass., 99 First St., Watertown, Mass., 11 Galen St.

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Gear Coupling

What is described as a simplified, inexpensive mill motor type flexible gear coupling accommodating mill motors with tapered shafts is offered by Sier-Bath Gear and Pump Co., Inc., 9284 Hudson Blvd., North Bergen, N. J.

The coupling has a sleeve and one hub of standard design, with the other hub taper bored to specification and a space provided for a nut on the end of the motor shaft. As with the firm's standard flexible gear coupling, the overall size of the mill motor type is about three-fifths that of conventional couplings of the same shaft size and about half the usual weight. Horsepower capacity is said to be greater than that of conventional flange-and-bolt types.

Mill motor flexible gear couplings are available in stock sizes $^7/_8$ to 6, with capacities ranging from 4 to 600 hp-per-100 rpm.

BUSINESS NOTES

Texas Representative

A. W. Cash Co., Decatur, Ill., has announced the appointment of Erickson Industrial Products Co. as north central Texas representative for Cash Standard valves, controllers, governors and regulators, and Cash Standard Stacon temperature regulators. The firm has offices at 6234 Peeler St., Dallas 19, Tex.

Insulation Contractor

The Industrial Insulations Div., of Johns-Manville has named the Thorpe Insulation Co. as its insulation contract unit in the Gulf Coast area. In its new capacity Thorpe, which maintains offices at Houston, will handle contract installations of insulating materials in this area.

Relocates Sales Office

American Felt Co., has opened a new district sales office at the Empire State Bldg., New York, N. Y. Formerly located at 200 Fifth Ave., New York, American's district sales staff will continue to serve the Eastern seaboard area from Connecticut to Florida. The company is headquartered in Glenville, Conn. and is represented by sales offices throughout the country.

Forms New Division

Crucible Steel Co. of America has formed a new division for the fabrication and sale of steel springs. Known as the Spring Div., the new organization combines all previously existing Crucible spring fabrication and sales activities including Spring Wks., Pittsburgh, and the company's Railroad and Spring Sales Div.

SAFETY CODES

Now Serving as Guides

to manufacturers, purchasers, and users of equipment and to state and municiple authorities having jurisdiction over the subjects within the scope of these documents.

CODE FOR PRESSURE PIPING
B31.1 — 1955 $3.50

Covers design, fabrication, materials, installation, and testing of the following systems and piping components: power piping, industrial gas and air piping, refinery and oil transportation piping, district heating piping, and refrigerating piping systems.

GAS TRANSMISSION AND DISTRIBUTION PIPING SYSTEMS
B31.1.8 — 1955 $2.50

Design, fabrication, installation, testing and the safety aspects of operation and maintenance of these facilities are covered.

CRANES, HOISTS, DERRICKS
B30.2 — 1943 (Reaffirmed 1952) $1.80

Presents rules for construction, installation, and maintenance of cranes and derricks driven by steam engines, electric motors, or internal combustion engines; for simple drum hoists; overhead electric, and overhead air-hoists; and handpowered derricks.

INDUSTRIAL POWER TRUCKS
B56.1 — 1955 $1.00

Applying to both the driver-ride and driver-lead types, this Code promotes safety to personnel and equipment by establishing uniform fundamentals of certain elements of design and by setting up rules for operation and maintenance of the trucks.

ELEVATORS, DUMBWAITERS, AND ESCALATORS
A17.1 — 1955 $3.50

Gives safety requirements relating to the design, construction, operation, installation, tests, maintenance, alterations, and repairs of hand and power passenger and freight elevators, hydraulic elevators, power and hand sidewalk elevators, private residence elevators and inclined lifts, dumbwaiters, and escalators.

NATIONAL PLUMBING CODE
A40.8 — 1955 $3.50

An up-to-date set of requirements applying to the design, installation, inspection, tests and maintenance of plumbing systems. Contains trailer coach and trailer park standards, and administrative data for law enforcement agencies.

MECHANICAL POWER TRANSMISSION APPARATUS
B15.1 — 1953 $1.00

Contains rules for safeguarding all revolving and reciprocating parts of equipment used in the transmission of power including connecting rods, cranks, flywheels, shafting, pulleys, belts, chains, ropes and drives, gears, clutches, counterweights, belts, keys, set screws, etc.

20% Discount to ASME Members

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KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Appoints Pump Distributor

The Pump Dept. of Ampco Metal, Inc., Milwaukee, Wis., has announced the appointment of Marine Engine Specialties Corp., 556 Broome St., New York 13, N. Y., as a centrifugal pump distributor. The Marine Engine firm is franchised to supply the interchangeable Series "D" centrifugal pump and the established "Z" type as well as parts for both models.

LATEST CATALOGS

Lubrication Brochure

Brochure B-3, showing technical advances of solid film lubrication is now available from Electrofilm, Inc., North Hollywood, Calif. The firm's engineers state that its solid film lubrication process inhibits fretting corrosion, prevents galling and seizing, lubricates under high loads, high speeds, high and low temperatures from −100 to +700 F (in some applications to 1100 F), and always produces dry, clean and dust free operation.

Gyros Bulletin

Norden-Ketay Corp., Dept. ME, Halesite, Long Island, N. Y., has issued bulletin No. 380 giving specifications and characteristics of available compensated vertical gyros, ruggedized fully floated gyros and directional gyros. Also included are miniature precision potentiometers and dual sine-cosine potentiometers.

Bearing Catalog

A 72-page catalog on self-aligning roller bearings has been published by the Chain Belt Co., Milwaukee 1, Wis. The catalog contains specification and data pages on all models with shaft sizes that range from $^3/_4$ to 7 in.

It also describes the Shafer self-aligning principle of concave rollers running between convex raceway, the Shafer micro-lock Adjustment, and Shafer "7" Seal. Included in the catalog is completely revised engineering data, new load rating tables, exploded view for parts identification.

O-Ring Seal Design

An all new engineering handbook, No. 525, is announced by Plastic and Rubber Products Co., 2100 Hyde Park Blvd., Los Angeles 47, Calif.

It contains charts, illustrations, graphs and all engineering data in the development of the O-ring seal design information on internal and external grooves, gland finishes, chamfers, selection of gland, piston rod, and cylinder materials and lubrication. Special sections of the handbook deal with silicone rubber products, custom molding, tables of decimal equivalents, temperature conversion table, circumference and area of circles.

CHROMALOX
Electric
TUBULAR HEATERS

provide controlled and dependable conduction, convection or radiant heat

These versatile Chromalox Tubular Heaters provide the kind of heat you need, exactly fitted to your specific heating application.

Available in straight lengths or formed to any desired shape. Used for heating dies, molds, platens; as immersion heaters in liquids, soft metal and molten salts; or in ovens, air ducts and other air heating applications.

Let the Chromalox Sales Engineering staff solve your heating problems . . . electrically

Write for your copy of Catalog 50

—for full information on the complete line of Chromalox Electric Heaters and controls.

For ideas on additional applications of electric heat, request Booklet F1550—"101 Ways to Apply Electric Heat."

Edwin L. Wiegand Company

7646 Thomas Boulevard, Pittsburgh 8, Pennsylvania

EDWIN L. WIEGAND COMPANY
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I would like to have . . .

☐ a copy of Catalog 50
☐ a copy of "101 Ways"
☐ a Sales Engineer contact me.

Name_____

Company_____

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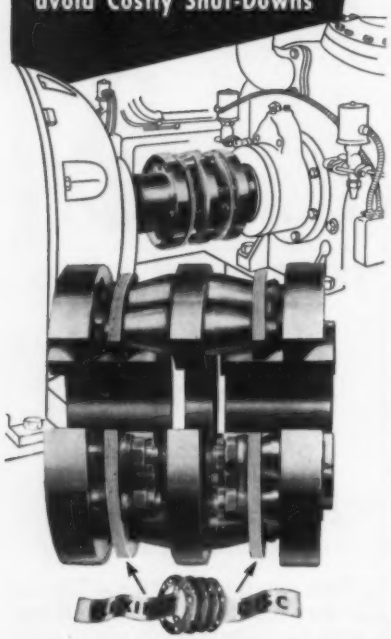
A-4466A

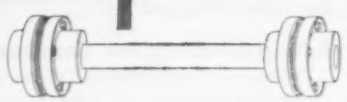
Specify THOMAS ALL METAL
FLEXIBLE COUPLINGS
for Power Transmission to avoid Costly Shut-Downs

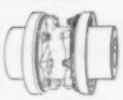


Patented Flexible Disc Rings of special steel transmit the power and provide for parallel and angular misalignment as well as free end float.

DISTINCTIVE ADVANTAGES

FACTS	EXPLANATION
NO MAINTENANCE	Requires No Attention. Visual Inspection While Operating.
NO LUBRICATION	No Wearing Parts. Freedom from Shut-downs.
NO BACKLASH	No Loose Parts. All Parts Solidly Bolted.
CAN NOT "CREATE" THRUST	Free End Float under Load and Misalignment. No Rubbing Action to cause Axial Movement.
PERMANENT TORSIONAL CHARACTERISTICS	Drives Like a Solid Coupling. Elastic Constant Does Not Change. Original Balance is Maintained.





Thomas Couplings are made for a wide range of speeds, horsepower, shaft sizes and can be assembled or disassembled without disturbing the connected machines, except in rare instances.

Write for new Engineering Catalog No. 51A

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Pipe Insulation

Literature describing and illustrating low pressure pipe insulation for cold, hot water and low pressure steam lines has been published by Owens-Corning Fiberglas Corp., Toledo 1, Ohio.

The publication, identified as IN1.C7, includes seven photographs, two charts and a graph in four pages. Physical properties, thermal performance and limitations are described for the pipe insulation, manufactured with two types of jackets, one a new heavy, white outer-bleached kraft paper laminated to an interior vapor barrier facing of aluminum and the other of standard weight canvas.

Industrial Presses

A comprehensive, illustrated 16-page bulletin, designated DH-486, has been issued by Manley Div., American Chain & Cable Co., Inc., York, Pa.

It is principally devoted to the firm's line of hydraulic and air-operated industrial presses of 25 to 150 ton capacity. A total of 10 different models are featured. Detailed specifications capabilities, capacities and accessories have been incorporated in tabular form together with photographs and outline drawings. Detailed information is also included on 3-ton capacity arbor presses, 2-ton capacity mobile floor crane, two 2-ton capacity mobile floor trestles and a 2-ton capacity universal floor crane.

Compressed Air Dryers

Dryers for compressed air and gases manufactured by Murphy & Miller, Inc., 1326 S. Michigan Ave., Chicago, Ill. are illustrated and described in a new circular just released by the company. Features and operating details of the automatically operating dryers are included.

Steel Tubing

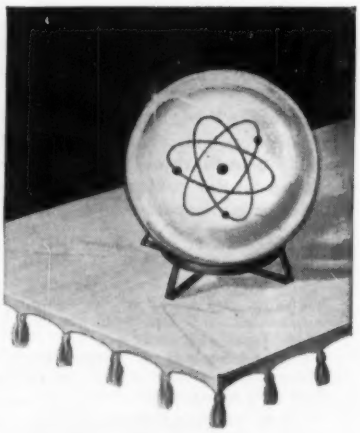
An eight-page catalog describing four major classifications of carbon and alloy steel tubing: mechanical, pressure, airframe and aircraft mechanical, has been issued by the Ohio Seamless Tube Div., Copperweld Steel Co., Shelby, Ohio. Entitled "Ostuco Tubing," the catalog covers both seamless and electric resistance welded tubing, as well as tube fabricating and forging.

Temperature Controls

Partlow Corp., 2 Campion Rd., New Hartford, N. Y., has issued an eight-page condensed catalog containing model illustrations and brief descriptions of temperature controls and allied equipment for industrial heating and refrigeration for applications ranging from −30 to +1200 F.

Included are recording controls, indicating controls, non-indicating controls (electrical and mechanical), thermometers, bulb installation accessories, how to order thermal elements, process timers, gas pilots.

Continued on Page 72



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Edward Impactor handwheel seats big valve tightly—allows one man to do the job of three.

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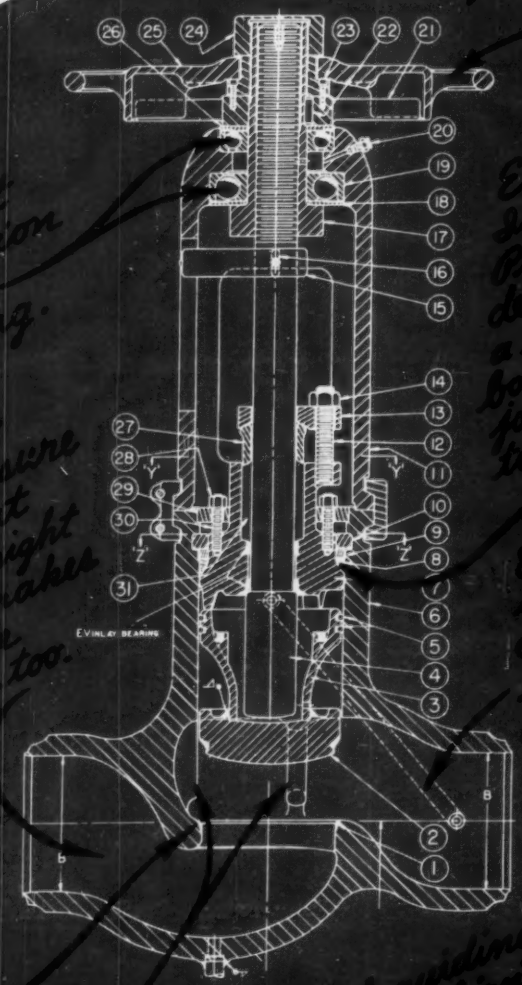
When it comes to steel non-return valves, let's order Edward and have them quote on other valves too.



LIST OF MATERIALS
QUANTITIES ARE FOR ONE VALVE
WHERE A.S.T.M. SPECIFICATIONS ARE INDICATED, THE LATEST REVISION APPLIES

PIECE NO.	NAME OF PIECE	NO. REQ'D	MATERIAL	SPECIFICATIONS	EDWARD NUMBER
1	SEAT	1	STELLITE	INTEGRAL WITH BODY	4181
2	DISK	1	FORGED ALLOY STEEL STELLITED	A.S.T.M. A182, GRADE F11	227 4181
3	PISTON-WELDED TO DISK	1	CAST STEEL	A.S.T.M. A216, GRADE WCB	102
4	GUIDE	1	CHROMOLY	A.S.T.M. A182, GRADE F5	107
5	PISTON RINGS	2	SPIRALLOY	A.S.T.M. A296, GRADE CA 15	218
6	BODY	1	CAST STEEL C-0.35% MAX CAST STEEL C-0.20% MAX CAST STEEL C-0.18% MAX	A.S.T.M. A216, GRADE WCB A.S.T.M. A217, GRADE WC6 A.S.T.M. A217, GRADE WC9	102 106 242
7	BONNET	1	CAST STEEL	A.S.T.M. A217, GRADE WCB	102
8	PRESSURE SEAL GASKET	1	ARMCO IRON	MALLEABLE PLATED	502
9	SPACER RING	1	STEEL		
10	EQUALIZER RETAINER	1	STEEL	A.S.T.M. A108, GRADE 1015	218
11	YOKE	1	CAST STEEL	A.S.T.M. A216, GRADE WCB	102
12	GLAND STUDS	2	ALLOY STEEL	A.S.T.M. A193, GRADE B7	193
13	GLAND FLANGE	1	CAST STEEL	A.S.T.M. A216, GRADE WCB	102
14	GLAND BOLT NUTS	2	STEEL	A.S.T.M. A194, GRADE 1	134
15	STEM GUIDE COLLAR	1	STEEL PLATE	A.S.T.M. A107, GRADE B	133
16	STEM BUSH KEY	1	STEEL	SAE 1020	
17	YOKE BUSHING	1	CAST BRONZE	A.S.T.M. B148 GRADE 9A-9Y	452
18	BEARING WASHER	1	STEEL-CHROMIZED	A.S.T.M. A322, GRADE 3	115
19	ANGULAR CONTACT BALL BEARINGS			SAE STANDARD	
20	ALEMITE FITTING	1	PRESSURE-DEAD INDUSTRIAL TYPE		
21	GOVERNOR	1	CAST STEEL	A.S.T.M. A216, GRADE WCB	102
22	CROSSPIN KEY	1	STEEL	A.I.S.I. C1035	120
23	HANDWHEEL BUSHING	1	BRASS	A.S.T.M. B62	472
24	HANDWHEEL ASSEMBLY	1	STEEL PLATE	A.S.T.M. A285, GRADE D	133
25	IMPACTOR HANDWHEEL	1	CAST IRON	A.S.T.M. A126, CLASS B	301
26	BEARING WASHER	1	STEEL-CHROMIZED	A.S.T.M. A322, GRADE 3	115
27	GLAND	1	STEEL	A.S.T.M. A108, GRADE 1020	120
28	BONNET RETAINER NUTS	6	STEEL	A.S.T.M. A194, GRADE 2H	137
29	BONNET RETAINER RING	1	STEEL PLATE	A.S.T.M. A212, GRADE B	112
30	BONNET RETAINER STUDS	6	ALLOY STEEL	A.S.T.M. A193, GRADE B7	206
31	PACKING RINGS		HIGH TEMPERATURE PACKING		

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GENERAL ASSEMBLY

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APP'D	DATE:	

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Injection Molding Machine

A six-page bulletin describing the operating features and specifications of a preplasticizing type plastics injection molding machine is being offered by Watson-Stillman Press Div., Farrel-Birmingham Co., Inc., 109 Aldene Rd., Roselle, N. J.

The bulletin also describes such design features as an improved heating cylinder, new base design, prefill system, preplasticizer unit and accessory equipment. Complete information on machine speeds and die space dimensions is also included.

Germanium Rectifier

A new bulletin describing Model G125-400 Fifty KW heavy duty germanium type rectifier is available from Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif. Features, specifications and applications of this new heavy duty germanium type rectifier are outlined in this bulletin.

The unit has an a-c output voltage range of 115 to 125 volts at 400 amp and is a unique cubicle which can be series and/or parallel connected for voltages and amperages as required. The unit is used by power utilities for d-c elevator drives and also in the chemical processing industry.

Carbon Graphite

Pure Carbon Co., Inc., St. Marys, Pa., announces the publication of a technical reference catalog, Bulletin No. 55, on carbon-graphite especially designed for mechanical applications.

Metalworking Machines

A 44-page complete line catalog describing how Di-Acro metalworking machines perform forming, cutting, punching and notching operations in medium and light weight materials is available from O'Neil-Irwin Mfg. Co., 569 Eighth Ave., Lake City, Minn.

A feature of the catalog is the arrangement of machine specifications and material forming capacities in tabular form. Additional pages list complete specifications and cost information on standard press brake dies and press brake engineering tables. Standard punch press punch and die listings with cost information is also given.

Aerodynamic Testing

A new 20-page booklet, "Hagan Automatic Controls for Aerodynamic Testing Facilities," is now being made available by Hagan Corp., Pittsburgh 30, Pa.

The booklet describes the company's series of components, a high-speed, high-powered line of precision electrical and electronic automatic control equipment for all standard variables. The series is designed for use in aeronautical testing and other facilities requiring exact performance. Typical applications include the control of surge, altitude and mass flow in all types of wind tunnels.

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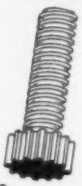

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Tacker-Stapler Bulletin

Industrial Fastener Div., Heller Corp., 2135 Superior Ave., Cleveland 14, Ohio., has just issued a four-page bulletin, 1503-17, on its pneumatic tacker-stapler designed for one-hand high speed fastening.

The bulletin gives specifications of the stapler with and without anvil; describes various applications of the tacker-stapler on production lines, in shipping rooms and for maintenance departments.

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A good book to consult for authorized definitions of approximately 500 occupational specialties in engineering.

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KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Mechanical Seals

Chemically inert mechanical seals for handling acids, corrosives, solvents and gases are described in a new eight-page illustrated technical bulletin available from Crane Packing Co., Dept. MXN, 6400 Oakton St., Morton Grove, Ill. The bulletin provides construction, service and application information, including representative installations and engineering details. The mechanical seals described are the "John Crane" Types 9, 9B and 9A in the various construction styles in which they are available. They incorporate sealing members fabricated from Teflon. Metallurgical construction is governed by the service specifications. They can be used over a wide range of temperature conditions from −120 to +500 F and pressures to 750 psi.

Silicone Varnish

An eight-page data sheet describing the uses, properties, and application procedures of R-620 silicone impregnating varnish for high-temperature electrical insulation systems is now available from Silicones Div., Union Carbide and Carbon Corp., 30 East 42nd St., New York 17, N. Y. The material is sold as a 50 per cent silicone resin in hydrocarbon solvent. The cured varnish meets or exceeds the requirements for high-temperature impregnating varnishes established by the Navy, the AIEE (Class H) and the NEMA standards (Group III). It is used principally in the varnishing or coating of electric coils, armatures, and stators in electric motors, generators and transformers intended for high-temperature or heavy-duty service.

Gate Valve

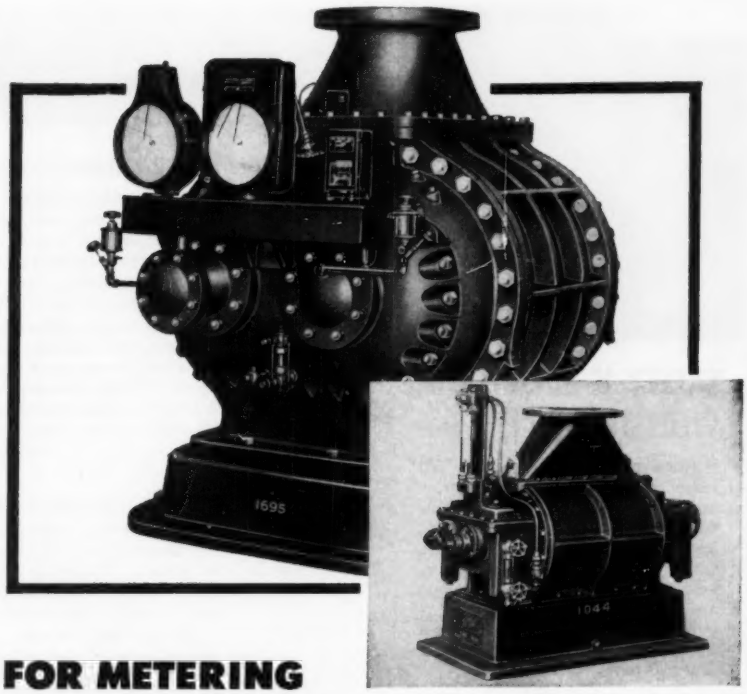
A brochure describing a renewable seat ring gate valve, which never has to be removed from the line to replace seat rings, is available from Fairbanks Co., 393 Lafayette St., New York 3, N. Y.

A series of photographs describing how seat rings are replaced without removing valve body from the line. Cutaways and details are included in the brochure.

Electric Brakes

Warner Electric Brake & Clutch Company, Beloit, Wis., has announced the availability of an eight-page bulletin, Form WEB 6212, which describes its line of electric brakes and clutches.

These devices utilize an electro-magnetic principle to provide a way to control a variety of machine motions. Electrical actuation time can be measured in milliseconds and mechanical translation time can be eliminated to permit faster, more accurate starts and stops. Included in the bulletin are specifications for primary electric brakes, clutches, and clutch-brakes; fractional horsepower "RF" electric brakes, "SF" electric clutches and clutch-couplings; and integral horsepower electric brakes and clutches.



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KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Titanium Corrosion Resistance

A bulletin offered by Mallory-Sharon Titanium Corp., Niles, Ohio, contains currently available data on the corrosion resistance of titanium, and suggests where the metal can be applied to overcome corrosion problems. Various uses are described.

Titanium has resistance to such industrial chemicals as nitric acid, wet chlorine and chloride solutions, as well as sea water and chloride salt solutions. It is not susceptible to stress corrosion and shows high resistance to cavitation and fluid erosion, the firm states.

V-Belt Bulletin

V-belts are the subject of a new bulletin recently issued by Worthington Corp., Oil City, Pa. The bulletin contains illustrations of the many types of V-belts available for drives employed in heavy industrial applications and miscellaneous light machinery drives.

Featured are the steel cable belts which have the highest horsepower rating of any standard section V-belt. They are especially adaptable for drives requiring extra strength and heavy continuous service. High tensile airplane type steel cables, a revolutionary development in body construction, carry the load.

Mechanical Drive Turbines

High speed mechanical drive turbines, operating at speeds ranging up to 10,000 rpm and above, are described in a new publication designated GEA-6232, available from General Electric Co., Schenectady 5, N. Y. Construction and design features of turbine drives for centrifugal compressors and blowers are covered in the new bulletin. Cross sections, schematic drawings, cutaways, and typical installation photos point out design features and applications for single-valve, single and multi-stage turbines, as well as multi-valve multi-stage and multi-valve single-stage units for high back pressure applications.

Precision Ball Bearings

A comprehensive technical reference manual and catalog on small precision instrument ball bearings has been made available by New Hampshire Ball Bearings, Inc., Peterborough, N. H.

The 30-page, illustrated book features a basic survey article, "Factors to Consider in Selecting Small Instrument Ball Bearings." It stresses such considerations as types of bearings available, materials, components, engineering standards, tolerances, and the computation of dynamic and static loads. Additional discussion is given to handling methods and lubrication, with a section devoted to applications.

Plastic Tooling

A new mailer, entitled "Why Plastic Tooling?", has been published by Bakelite Co., Div. Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y. It tells how tooling compounds based on epoxy resins can cut production costs and simplify model changeovers by providing inexpensive, easy-to-build jigs and fixtures, forms, patterns and dies.

For each of the 39 applications listed, tooling compounds based on epoxy resins provide direct savings in initial investment by reducing the need for skilled labor and eliminating the need for much costly machining, the firm claims.

Catalog on Controls

An illustrated 12-page catalog showing controls specifically engineered to provide better operation of presses and press accessories, automatic feed devices and scrap cutters is offered by Danly Machine Specialties, Inc., 2100 S. Laramie Ave., Chiago 50, Illinois.

The book explains how such controls can provide efficiency, flexibility and safety to presses, dies, and operators. Among the features described and illustrated are: a single main control enclosure for simplified maintenance or adjustment of controls; built-in electric power and air pressure outlets; fingertip master control panel; pretesting of all control circuits before delivery of press; parting line mounting of terminal boxes.

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KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Steel Castings

Empire Steel Castings, Inc., Reading, Pa., has issued a new designation chart for corrosion resistant stainless steels. The chart identifies ACI and the firm's designations with the corresponding AISI type number, the ASTM designation and with other designations and trade names of similar alloys in order to correlate the various stainless types for easy selection and reference.

The chart also designates percentages of principal alloying elements and typical mechanical properties for the 23 steels listed. Remarks indicate the application and performance of many of the steels in use.

Straight Thread Fittings

L & L Mfg. Co., Van Dyke, Mich., offers three new sealing applications on straight thread fittings, in a 24-page brochure.

The brochure describes, explains, and illustrates a captive nut fitting that seals without O-rings; a metal ring seal fitting; and an O-ring seal fitting.

Metal Finishing

A new 12-page booklet, G-20, on metal finishing standards is offered by Allen Mfg. Co., 133 Sheldon St., Hartford 2, Conn. Described by the company as "a real first in the socket screw industry," the new booklet covers plating and surface treatment of the firm's products very thoroughly. Included are general facts on metal finishing, various types of plating, and types of surface treatment.

Test Equipment

A 16-page booklet, illustrating and describing many types of environmental test equipment is available from Murphy & Miller, Inc., 1326 S. Michigan Ave., Chicago, Ill. General performance and operating data on the equipment are included in the book.

Resistance Welders

Precision Welder & Flexopress Corp., Cincinnati, Ohio, has published a six-page bulletin covering its line of resistance welders, In addition to its standard and semi-standard line of resistance welders. The bulletin, No. G-100, describes Precision specials, designed and tooled to solve specific and unusual production problems.

Precision Fasteners

Standard Pressed Steel Co., Jenkintown, Pa., has issued a revised edition of its catalog covering standard Unbrako fasteners.

The 30-page catalog carries tables showing size ranges and specifications for socket head cap screws in regular, giant, and microsizes; regular microsize socket set screws; square head set screws; stripper bolts; flat head socket cap screws; button head socket cap screws; socket head dryseal pressure plugs; precision ground dowel pins; and socket screw keys to fit all types and sizes of socket head fasteners.

Silicones Bulletin

Raybestos-Manhattan, Inc., Passaic, N. J. has announced the release of an eight-page brochure featuring silicone rubber products and silicone coated cloths.

In addition to complete specifications on the various silicone compounds available, the bulletin provides data on the properties of silicone rubber, as well as resistance qualities of it against a wide variety of conditions. The limitations and service recommendations are fully covered. Government specifications which various compounds meet are included.

Stainless Steel Pipe

An eight-page technical folder issued by Tubular Products Div., Babcock & Wilcox Co. Beaver Falls, Pa., deals with the use of seamless and welded stainless steel pipe and stainless steel welding fittings in the process industry where corrosion and/or elevated temperatures are determining factors.

The folding contains application data on the most widely used stainless steels and furnishes hints on the bending, joining and welding of these products. Copies of the folder, TB-410, can be obtained from the company.

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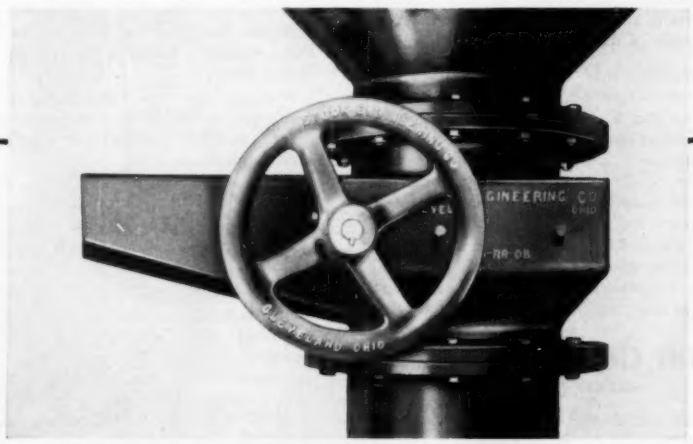

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THE CINCINNATI GEAR CO.
CINCINNATI 27, OHIO
"Gears—Good Gears Only"

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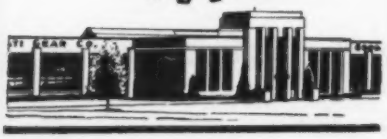

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Aircraft Castings

Lebanon Steel Foundry, 114 Lehman St., Lebanon, Pa., has published case histories of two aircraft steel castings now in quantity production using the firm's Ceramicast process.

The castings described are the backing for the Bendix disc type aviation brake, and a support fitting for the jet engine removal track in the Chance Vought "Crusader" (F8U-1). The case histories describe how the castings were originally produced in other materials or by other methods, and how the Ceramicast process was utilized to produce castings of greater strength, and at lower cost.

Electronic Air Cleaner

Field assembled electronic air cleaners are described in a 12-page catalog issued by Trion, Inc., 1000 Island Ave., McKees Rocks, Pa.

Complete engineering data, size and capacity tables and component parts description are included. The cleaners are installed in ventilating system air returns and are said to remove practically all dirt from the air stream.

Industrial Wire Rope

Wire Rope Recommendations for Industrial Services, a 24-page bulletin, No. DH-129D, has been issued by Hazard Wire Rope Div., American Chain & Cable Co., Inc., Wilkes-Barre, Pa.

It covers more than 120 different types of wire ropes used in construction, in conveyors, cranes, dredges, railroads, steel mills, and blast furnaces.

Pumping Meter

An eight-page, three-color bulletin describing an improved meter that pumps has just been released by Hills-McCanna Co., 2433 W. Nelson St., Chicago 18, Ill.

The bulletin describes the features of the improved meter which include improved accuracy at small flow rates and a new capsulated liquid end. Complete capacity tables (Range: 08 cc/min to 6 gph) and a detailed schematic of the meter are also included.

New Product Brochure

Gulton Industries, Inc., Metuchen, N. J. has announced the availability of a new 12-page, illustrated guide to the products of its five associated companies: Gulton Mfg. Corp.; Glenco Corp.; Vibro-Ceramics; Greibach Instruments Corp.; Thermistor Corp. of America.

The activities of these integrated companies extend from basic materials research to electronic components and systems and on to precision instruments of various types. Included is technical information about 65 diversified advanced product lines. Also shown are photographs of individual manufacturing processes.

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Engineering Corp.
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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Industry Sound Control

Industrial Sound Control, Inc., 45 Granby St., Hartford, Conn., has issued a catalog covering noise control for industrial air conditioning systems and a bulletin, "Silence Service for Industry," explaining the firm's facilities, methods and approaches for noise suppression in industrial and aviation applications.

The air conditioning catalog illustrates and describes the firm's Aircoustat, a packaged system. Graphs, specification tables and installation drawings are included.

Controlled Air Valve

A controlled closing air valve, Type CCAV, said to be a new concept for the protection of pipe lines against the damaging effects of surge and built-up pressures or water hammer, is illustrated in Bulletin No. 200 issued by the Simplex Valve & Meter Company, Lancaster, Pa.

According to the manufacturer, this device can control the speed of line closure, vent air and, if necessary, discharge water to prevent damage and also admit air to protect against pipe collapse from line breaks.

Submersible Motors

A 12-page booklet illustrating design and construction of water-lubricated submersible pump motors is available from Franklin Electric Co., Inc., Bluffton, Ind.

Cutaway photos show all components in color, including details of hermetically sealed windings, six-shoe thrust bearing, expansion diaphragm, filter-check valve and control box.

Electronic Analog Computers

A 16-page, illustrated catalog describing the firm's line of electronic analog computers has been released by George A. Philbrick Researches, Inc., 230 Congress St., Boston 10, Mass.

Descriptions are presented on the following: areas of application in industry, military and business; modular concept of building new or expanding existing installations; exclusive electronic graph paper for instantaneous and automatic calibration of both voltage and time on the oscilloscope and simultaneous display and precise comparison of as many as five variables; K3 series of analog computing components; new stabilized units; central signal components; regulated power supplies; K2 series of plug-in components offering the most computing per dollar invested; new function of two variables component; delay line synthesizer and other miscellaneous computing equipment.

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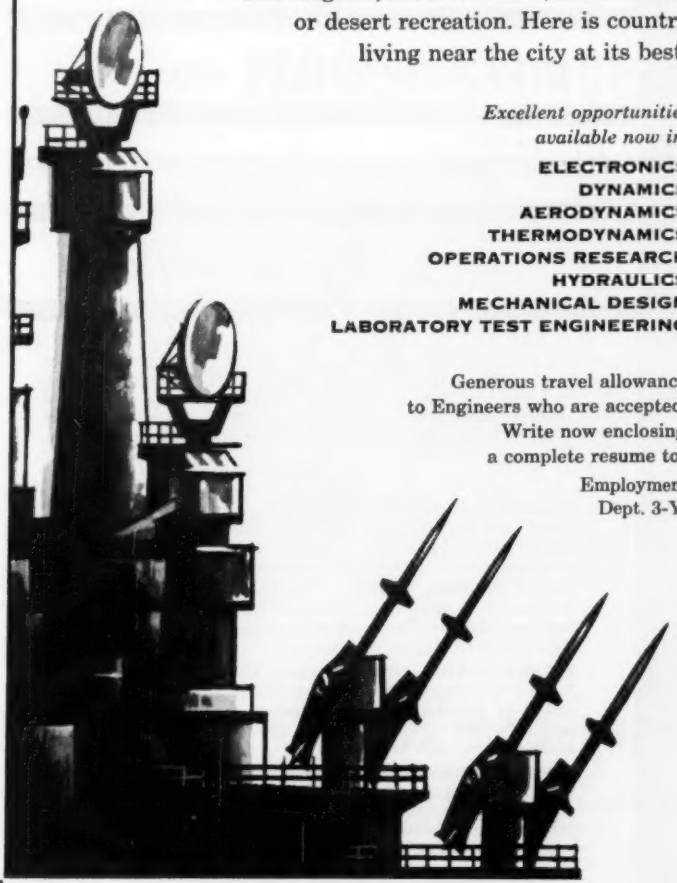

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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Timer, Recorder

Gorrell and Gorrell, Haworth, N. J., has issued data sheets covering its MD-Jr drum-type operations recorder which handles 400 linear inches on-off recording on a 6 × 12 in. waterproof chart, and its MG series electric timers in speed range from 40,000 to 1.

Both bulletins are illustrated and give specifications and operating characteristics of the units.

Oil Foggers

Metal Products Div., Koppers Co., Inc., Baltimore 3, Md., has issued a four-page bulletin on the protection of gas mains with the firm's oil foggers.

The units are described as sending a fine oil mist through any dry gas distributing system to stop minute leaks, eliminate dust problems and protect main joints, meters and regulators.

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The remarkable work now going on in our Missile Development Engineering makes it a very fruitful field for professional advancement in Plastics. If you would like to work on a variety of materials and applications in this program, now is the time to get started. You'll enjoy living in Southern California. Act now.

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SENIOR ENGINEER, PLASTICS: M.S., Chem. or M.E. Min. 4 yrs. experience in fabrication prototype glass reinforced laminated and sandwich structures, plastics, stress analysis. Duties: Consult, plan, write specs., supervise.

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ENGINEER, ADHESIVES: B.S., Chemistry, Chem. or Mech. Eng. Min. 2 yrs. exp. structural adhesives for metallic, non-metallic and sandwich applications. Knowledge of formulation a help. Consultation, new development, write specs.

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PLASTICS FABRICATORS: Min. 2 yrs. exp. on reinforced laminated or sandwich structures. Fabricate test specimens, prototype assemblies.

Please write: Mr. R. L. Cunningham, Missile Engineering Personnel Office, Dept. 91-20 ME, 12214 Lakewood Boulevard, Downey, Calif.

NORTH AMERICAN AVIATION, INC.

Vibration Mountings

Installation-proven all metal shock and vibration control mountings for machine tools, business equipment and other types of industrial applications form the subject matter of an eight-page bulletin, No. 1000, issued by Robinson Aviation, Inc., Teterboro, N. J.

The concept of all metal mountings with stainless steel cushions is explained, plus the advantages of Met-L-Flex resilient elements over rubber, cork, felt and synthetic elements. Methods of fabrication and mounting applications to attenuate vibration are shown for machine tools, mobile television, business office machines and vehicular engines. The firm's mounts include unit, plate-type and sandwich.

Hydraulic Ash Handling

An improved line of Hydroseal pumps for hydraulic ash handling systems is described in Data Sheet Pa, published by Allen-Sherman-Hoff Co., 259 E. Lancaster Ave., Wynnewood, Pa.

The 12-page data sheet uses photographs, schematics and line drawings to illustrate the design, construction and operation of these abrasion resistant centrifugal pumps. Tables give pumping capacities and related data, including friction loss in pipe and fittings. A cut-away view illustrates how the Hydroseal principle—a constant stream of clear water passing between moving parts—protects running clearances against wear and abrasion.

Rolled Barstock

Metals Div., Utica Drop Forge & Tool Corp., Utica, N. Y., has issued a bulletin giving technical information on Udimet 500, a centerless ground hot rolled barstock in sizes from $^1/_2$ to 2 in. diam.

The firm states other shapes can be supplied as hand forged or rolled material. The stock was primarily developed as an alloy for gas turbine components and is suited for applications where high strength at elevated temperatures is required.

Heat Controls

"Modern Control of Building Temperatures from Outdoors" is the title of a four-page illustrated bulletin issued by Automatic Devices Co., 714 Hillgrove Ave., Western Springs, Ill. The catalog describes and diagrams the manufacturer's line of outdoor-type automatic heat controls.

Weather controls available are time switches, set automatically by the outdoor weather; Weather-Man controls, in which outdoor temperatures automatically regulate the hours of building heat generation and the rate of heat flow; "indoor-outdoor" controls, which alter the heating system's temperature of water or air as the outdoor temperature changes.

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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Industrial Filtration

How industrial filters can lower production costs is the theme of a 10-page bulletin just released by R. P. Adams Co., Inc., 304 E. Park Drive, Buffalo 17, N. Y. Several simple case histories, including from filtering city water and the filtering of recirculation water from cooling towers and spray ponds, are cited.

The firm's new line of IWF filters is featured in the bulletin. Data includes sectional views in three colors, typical installation drawings, dimension charts and four color operational diagrams. Also included are three color sectional illustrations of an automatic filter and series filters.

Relief Valves

A 16-page catalog, Number 551, containing information on the selection, design, and function of relief valves, has just been issued by Fluid Controls, Inc., 1284 N. Center St., Mentor, Ohio.

The catalog illustrates and describes a variety of basic relief valves such as the pilot type, differential piston, guided piston, spring loaded, dual relief type, and features a separate section illustrating 30 other models. Each type is illustrated with detailed engineering drawings and performance charts. Specifications and operating data are included.

Agitator Drives

A bulletin on the operation and maintenance of the firm's PW drive for agitators used in chemical processing is offered by the Pfaudler Co., 1014 West Ave., Rochester, N. Y. It gives tips on motor installation and maintenance, has a chart on recommended motor horsepower and shows suggested agitator speeds.

Operating instructions and lubrication technics for the drive itself also are given. A drive with either a stuffing box or a rotary seal can be disassembled by the individual steps shown in the bulletin. Information and drawings given also indicate the methods for belt alignment and length, and for control of speed and load capacity of the variable speed sheaves.

Beryllium Copper Alloys

A eight-page catalog describing the methods and procedures used to heat treat Beryllium copper wrought and casting alloys is available from Beryllium Corp., Reading, Pa.

It tells how wrought alloys are supplied and describes both standard and special methods of heat treat hardening. Information is also included on fixtures, furnaces, annealing methods, cleaning and brightening. The cast alloy section describes the various alloys available in ingot form for customer re-melt. Complete tables of physical and engineering properties of various alloys available are also included along with data on melting, heat treating, special heat treating, furnaces and annealing.

Pump Bulletin

Ingersoll-Rand, 11 Broadway, New York 4, N. Y., announces a new bulletin, Form 7248-A, covering its re-designed line of DMV-DHV single-stage centrifugal pumps.

Designed for general hydraulic services, the pumps feature double mechanical shaft seals to eliminate stuffing box maintenance, and pre-lubricated, sealed ball bearings. Single mechanical seals are also provided for services where the liquid being handled is clean, and supplied at a positive suction pressure.

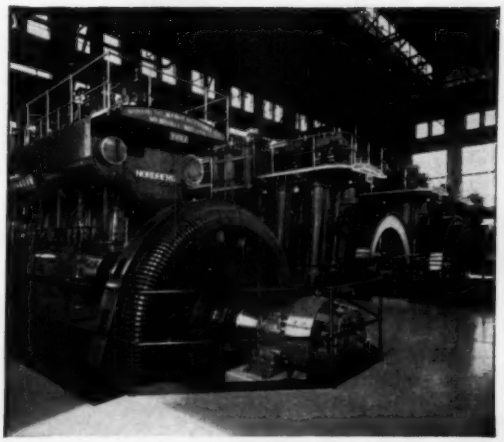
Ceramic Coating

Frenchtown Porcelain Co., 160 Muirhead Ave., Trenton 9, N. J., announces the publication of a four-page bulletin on Molcote, its new metallized ceramic coating for use with all types of hard solders.

The new development is a metal-to-ceramic coating presenting a surface to which a metal part or other metallized ceramic parts may be hard soldered up to 2200 F. It is applied to ceramic bodies by a special process and fired at high temperature.

WORN Cylinders?

SCORED Cylinders?



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Plastic Pipe Fittings

Two types of unplasticized polyvinyl chloride pipe and fittings are described in a product bulletin issued by the Alloy Tube Div., Carpenter Steel Co., Union, N. J. One type is a normal impact grade, and the other a high impact grade.

The bulletin gives a general description of both types, along with specific advantages. Applications are listed by industry and process, and corrosion resistance is defined. Tables give physical properties, dimensions and weight, maximum working pressures, types and weights, burst pressures, and thermal expansion and contraction. Installation instructions are given on cutting, threading, threading compounds, assembly of threaded joints, solvent cementing, bending, hanging and thermal compensation.

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Shell Molding

A 16-page booklet on resin-coated sand for shell molding is available from the Plastics Div., Monsanto Chemical Co., Springfield, Mass.

Describing resin-coated sand as more efficient than conventional resin-sand mixes, the booklet lists several of its advantages. In separate sections the booklet discusses resins, sands, equipment, coating techniques and the production of blown shell molds and shell cores. A section on trouble-shooting shell mold and core production is included.

Steam Generators

Two engineering bulletins on type-A and type-S water tube steam generators have just been released by Wickes Boiler Co., Div. Wickes Corp., Saginaw, Mich.

Bulletin No. 55-2 covers type-S boilers and Bulletin No. 56-1 is for type-A shop assembled boilers. Each includes descriptive material, photographs, and several separate data sheets of engineering drawings and technical information which are contained in a special pocket in the catalog.

Right-Angle Gearmotor

A new booklet that presents the Type R right-angle gearmotor for applications requiring 1–30 horsepower is available from Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

By means of photographs and diagrams, the booklet describes the construction and operation of the gearmotor, including the double-enveloping gears used in this new unit. A chart is also provided showing the relationship between output torque capacity and total gear ratio.

Steam Pumps

"How to Install and Take Care of Steam Pumps" is the title of a 23-page bulletin issued by Worthington Corp., Harrison, N. J.

A step-by-step series of 88 illustrations and appropriate captions presents the reader with information on increased service life of all types of steam pumps. The new literature also offers 28 tips on proper installation, and 54 tips on field-proven care techniques.

Wire Forming Facilities

A brochure entitled "Wire Forming Specialists" is offered by Risdon Mfg. Co., Naugatuck, Conn. Text and illustrations describe the company's ability and facilities for pointing, forming, stamping and finishing of products and components made from .015 to .250 in. diameter wire.

In addition to picturing a variety of formed wire products produced by the company, the brochure shows pointing, threading and other wire end operations performed. Also shown are examples of work produced on the firm's strip metal stamping and drawing facilities.

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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Molybdenum Borides

"Refractory Molybdenum Borides," a six-page bulletin describing applications; chemical, physical and mechanical properties; and preparation of molybdenum boride compounds, has been issued by Climax Molybdenum Co., Dept. L, 500 Fifth Avenue, New York 36, N. Y.

Complete data is given for four molybdenum borides and seven multi-boride systems. The latter include compositions of molybdenum borides with borides of nickel, chromium, cobalt, iron titanium, tungsten and zirconium.

Safety Cleanout Valve

Petrometer Corp., 43-22, 10th St., Long Island City 1, N. Y., announces the availability of a six-page bulletin on its safety cleanout valve for use on buried tank installations for storage of volatile, inflammable liquids. The bulletin describes the construction and operation features of the valve.

Heat Exchangers

A 24-page bulletin describing the latest developments in air-cooled heat exchangers has been published by Griscom-Russell Co., a subsidiary of General Precision Equipment Corp., Massillon, Ohio.

Bulletin 2400 describes the design details, construction, distinctive features and applications of an air-cooled unit known as the fin-fan exchanger. Also included in the bulletin are specifications, sketches of available arrangements, and descriptions of mechanical equipment and control apparatus for various service requirements.

Investment Castings

Design data developed over 10 years' of producing investment castings are outlined in a new 40-page booklet produced by Haynes Stellite Co., Div. of Union Carbide and Carbon Corp., 30-20 Thomson Ave., Long Island City, N. Y.

Typical physical, mechanical, and chemical properties of 26 investment-casting alloys are included. The alloys described were selected from over 300 tested under actual production conditions.

Flowmeter Catalog

Fischer & Porter Co., 692 Jacksonville Rd., Hatboro, Pa., has published a 16-page catalog describing its new glass tube variable-area Flowrator meters.

The catalog describes in detail the models available, various types of tubes and floats, predictable performance characteristics, construction features, and accessory equipment. A section devoted to extensions and secondary instruments, which can be used with the 1700 series meters, is also included.

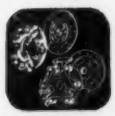
Shelving Catalog

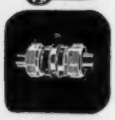
Tips on how to plan installations and order shelving in more than 1000 combinations are summarized in a new catalog published by the Hallowell Div., Standard Pressed Steel Co., Box 806, Jenkintown, Pa.

Drawings of basic units and accessories, suggested floor plans, a shelf-capacity chart and photographs of completed units make the catalog a useful guide to planned storage. The catalog information can be adapted to assembly lines, production areas, repair shops, tool rooms, aircraft maintenance hangars, business offices, stores and markets, schools, garages, service stations, libraries, hotels, military and naval installations, ships stores, banks, warehouses, swimming pools and athletic clubs, sports arenas, churches, homes.

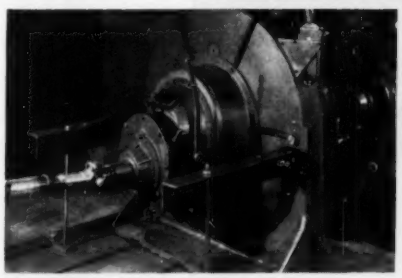
ROCKFORD

MEMO
Clutch must be conservatively rated –

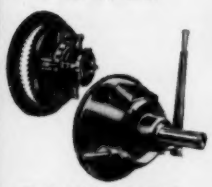




ROCKFORD POWER TAKE-OFFS are designed for generous overload capacity within the fields of service recommended by Rockford Clutch engineers.



POWER TAKE OFF



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CLUTCHES

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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Teflon Packings

An 8-page bulletin issued by Packing Div., Raybestos-Manhattan, Inc., Passaic, N. J., features a variety of packings and gaskets made of Teflon.

Illustrated and described are split and folded types of envelope gaskets, solid gaskets and Teflon stuffing box, vee-flex, braided, plastic and various types of valve stem packings. Complete service recommendations for each type packing is included as well as sizes in which they are available. The bulletin also includes information on the properties of Teflon.

Piping Stress Values

Bulletin TDC-154A published by Tubular Products Div., Babcock & Wilcox Co., Beaver Falls, Pa., gives the maximum allowable stress values for ferrous pipe and tubing.

Included are the values at various temperatures for a complete range of seamless and welded carbon, alloy and stainless tubing steels. Also included in the folder are the formulas to be used in connection with the stress value in calculating the maximum allowable working pressures.

Dust Control

A new product bulleting that describes different designs of exhaust hoods for dust control in the woodworking industry has been released by American Air Filter Co., Inc., 215 Central Ave., Louisville 8, Ky.

Emphasizing the fact that an important part of any dust collecting system is the exhaust hood, Bulletin 270-E3 describes localized applications. It tells how increased cutting speeds of modern woodworking machinery have increased the amount of work processed and, correspondingly, the volume of dust, shavings, and/or chips produced.

Centrifugal Pumps

Double suction single-stage centrifugal pumps are described and illustrated in a new eight-page bulletin, Catalog A-156, issued by C. H. Wheeler Mfg. Co., 19th and Lehigh, Philadelphia 32, Pa.

They are recommended, by the company, for general service wherever liquids of low viscosity are to be moved. Case is split on horizontal center line and rotating parts can be removed without disturbing piping. Cross section drawings and construction details for standard sizes up to 10-in. discharge are included.

Welded Chain

A catalog on welded chain, welded chain assemblies, and accessories has been published by the Bolt and Chain Div. of Republic Steel Corp., 3100 E. 45th St., Cleveland 27, Ohio.

The 62-page two-color catalog describes and illustrates more than 25 different types of welded chain and chain assemblies, plus accessories. Types of welded chain listed include proof coil, BBB, Republic alloy, high test, and a variety of other standard and special chain types.

Variable Speed Drive

A 44-page booklet, No. 20P50, carrying multi-color tables on variable speed "Texrope" drives has been released by Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis.

In addition to providing selection tables for A, B, C, and D section variable speed drives, the booklet includes information on design feature, drive principles, horsepower rating tables for A, B, C, D, and E section belts, a speed range table showing the variation in rpm when using two "Vari-Pitch" sheaves in combination, and accessory equipment for the "Vari-Pitch" drive.

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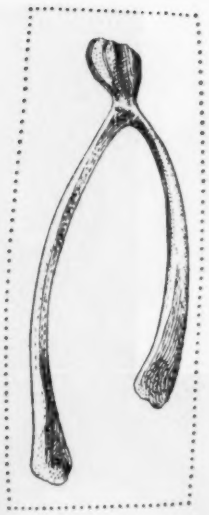

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Martin extends this invitation to Aeronautical, Mechanical, Electrical, and Structural Engineers and Technicians and to Mathematicians and Physicists. If you have already made other vacation plans however...

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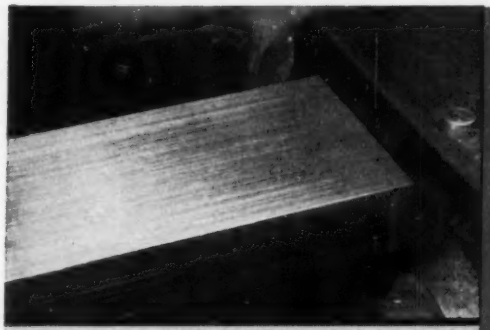
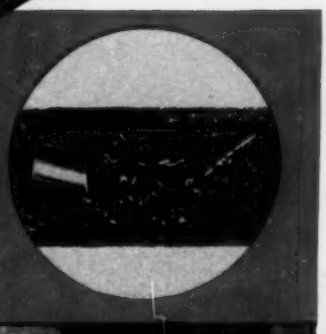
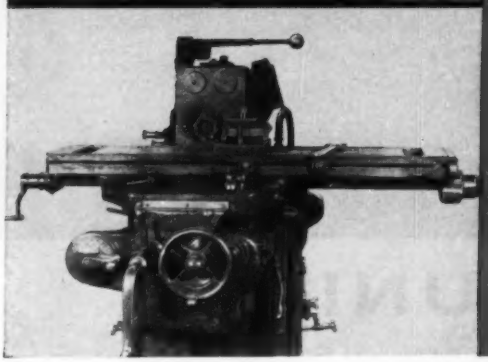


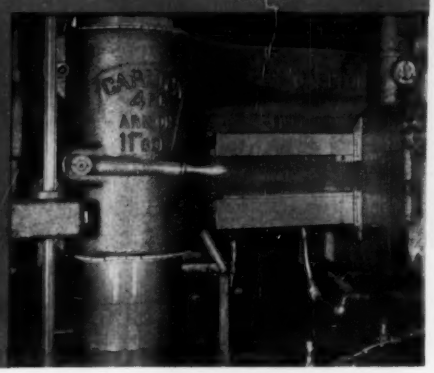
This close-up photograph shows harmful chips and abrasives trapped in a fibrous wiper that permitted scoring of the lathe way shown at left.

The extent of scoring and abrasion caused by chips trapped under the carriage is clearly shown in this photograph of a lathe way.





C/R Way Wipers are quickly, easily installed on this milling machine, as well as on shapers, grinders, planers, and gear cutters.



The clean, score-free wiping action of C/R Way Wipers is evident again in this partial view of a radial drill. Note how close, accurate lip contact on the column is achieved, even though the wiper is mounted on uneven surfaces.

How many hundreds of dollars are scoring and abrasion of machine tool ways costing your shop each year . . . dollars that could easily be saved? C/R Sirvene (synthetic rubber) Way Wipers make it unnecessary to tolerate this expensive damage. They are designed and precision molded for an extremely accurate fit. They will *not* trap harmful materials . . . will not mark or smudge ways. They will wipe ways clean of dirt, chips, fine abrasives . . . even water emulsions . . . yet leave a thin, protective oil film. C/R Sirvene Way Wipers will fit flat ways, side rails, angles, columns and hydraulic rams . . . and are easily installed. They will save you many times their cost. Please write for illustrated brochure that gives complete details.

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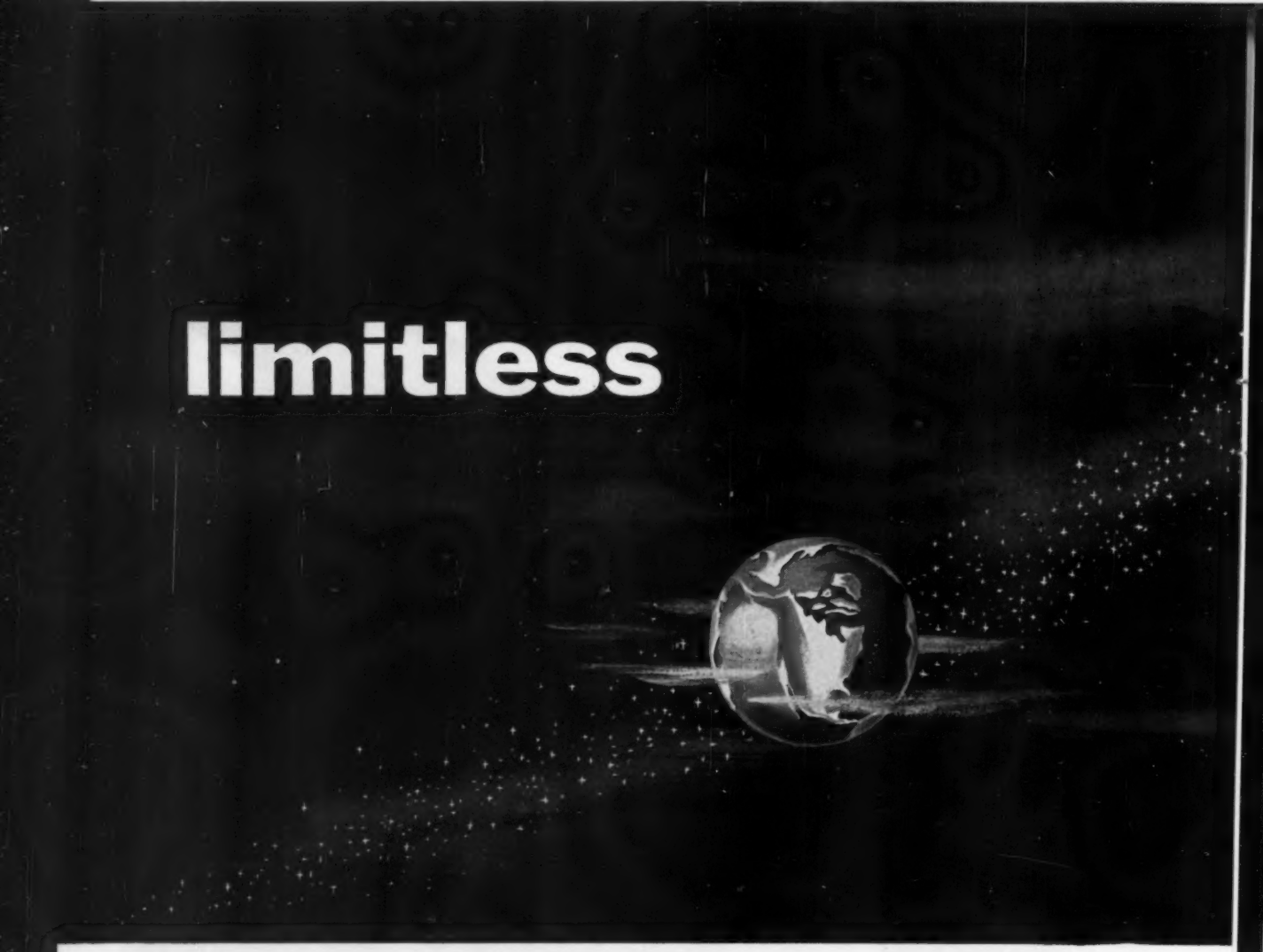

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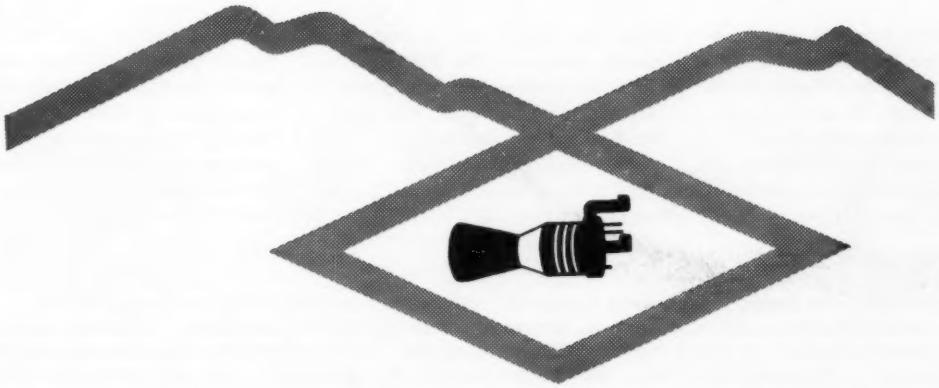

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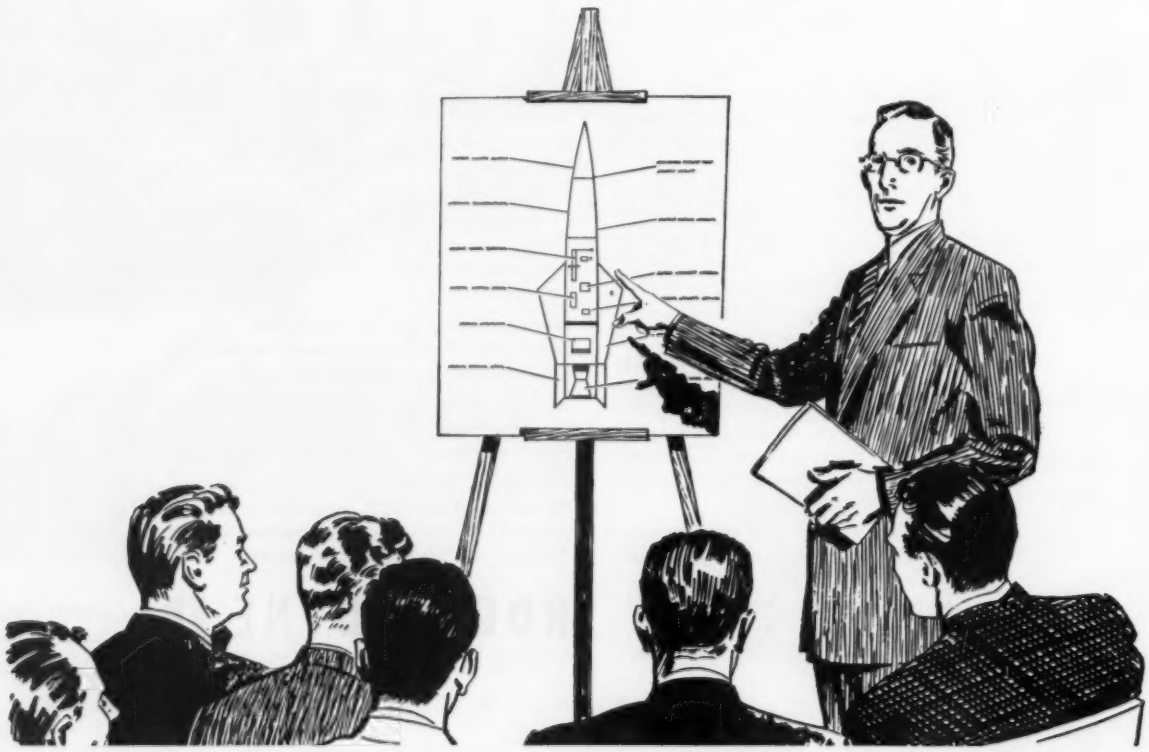

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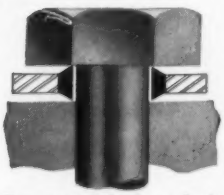
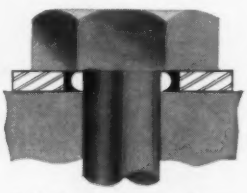


Dyna-seal before bolt head is drawn down



Bolt head drawn down —with pressure applied

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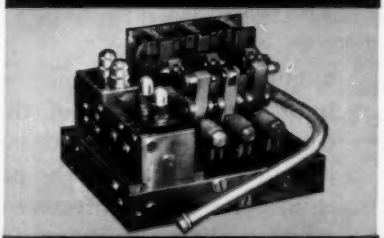
Dyna-seals provide uncompromising sealing performance under bolt heads of the nuclear submarine Seawolf periscope mounting.



30 Dyna-seals solve plug-leakage problem on The NATCO Hydraulic Control Unit manifold.

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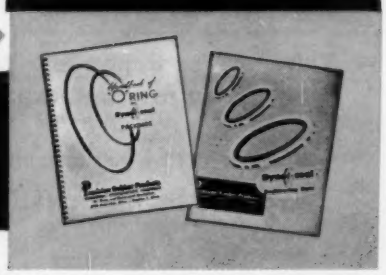

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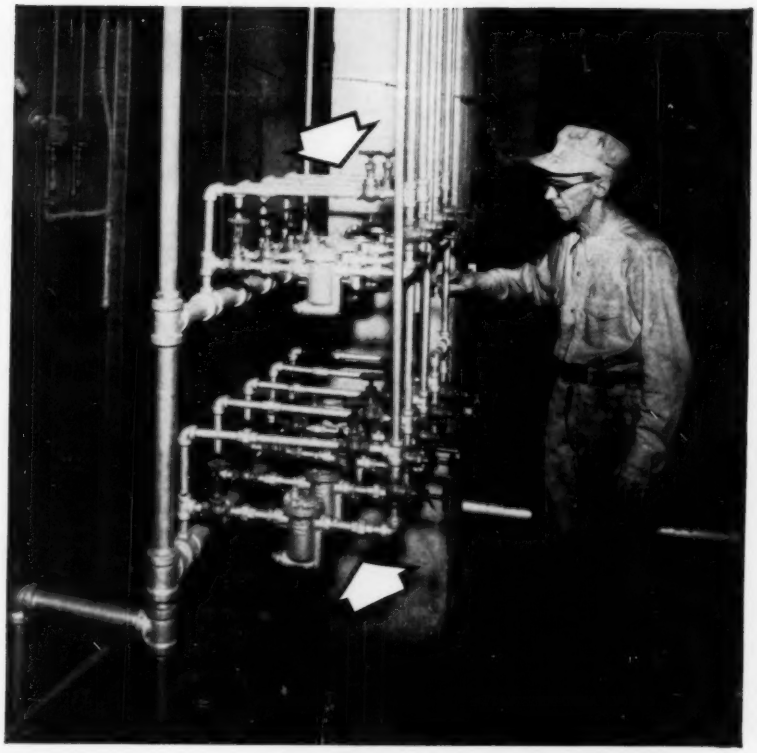
Good Trapping Practice with Good Traps Roy Davis, Maintenance Superintendent, looks over one of the well-engineered Armstrong trap installations he has made at the Masonic Temple in Detroit. Traps discharge to 15" vacuum.



Keeping the Coffee Perkin' with Armstrong traps draining steam heated coffee urns.

Detroit's Masonic Temple Solves Vacuum Loss by Installing Armstrong Inverted Bucket Steam Traps

MANY AN engineering hour has been spent ferreting out the leaks in a vacuum return system. Here's a tip if you have the problem: *check your steam traps.* Don't worry about *flash* steam from traps—look for the traps that are leaking *live* steam. Take the case of the big Masonic Temple in Detroit:

The 11,600,000 cubic foot building has banquet space for 4500 persons at a sitting. Imagine the bedlam in the kitchen when the steam heated cooking equipment couldn't meet dinner schedules!—simply because condensate drainage was sluggish. The cooks were always in a stew and calls to the maintenance department were daily occurences.

The building buys 35 lb steam from Detroit Edison. Line pressure is used for the cooking kettles, while regulating stations supply 2 to 3 lb steam for the heating system.

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Prior to the installation of Armstrong traps, maximum vacuum attainable was 4 inches and in some cases it was necessary to manually drain the systems and dump the condensate.

According to Roy Davis, Maintenance Superintendent, the installation throughout of Armstrong inverted bucket steam traps has solved the problem. "*I don't remember having had the chefs complain since . . . the kettles heat in a hurry now.*"

F. W. Emblin, Operations Manager, adds, "*You can check the vacuum gage any time now and seldom find less than 15" showing.*"

There's another nice part to this story that only time will reveal: Armstrong traps have a habit of delivering this kind of service on low pressure vacuum return systems for years and years without repairs. Your local Armstrong Representative has plenty of cases he can tell you about. Why not call him today?

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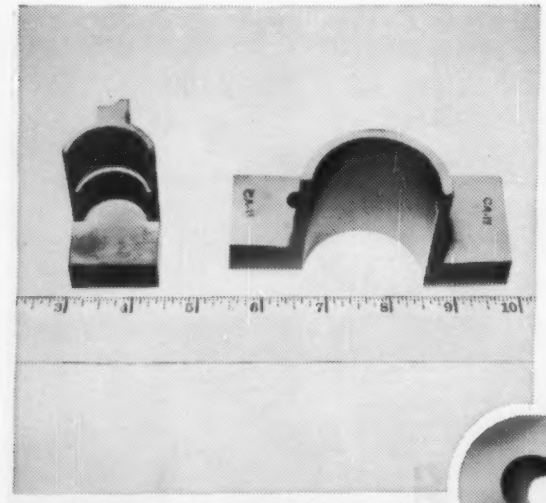

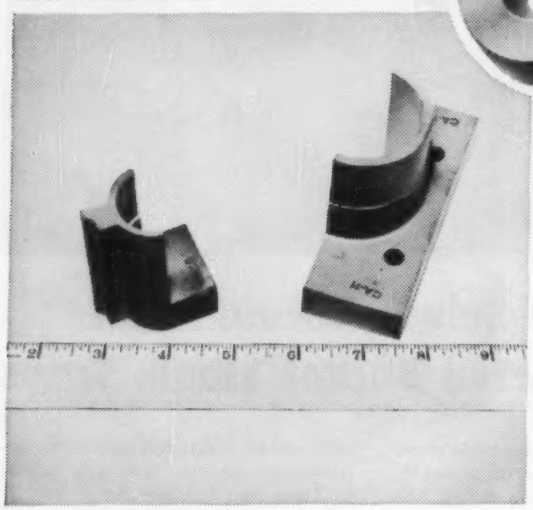

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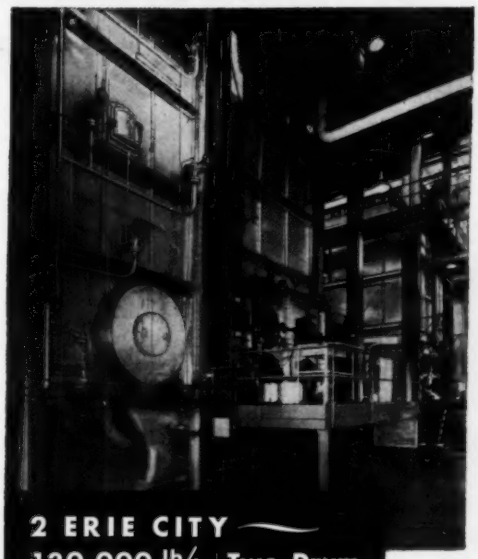

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Air view shows four of the five public housing projects for Housing Authority City of Baltimore, Maryland. The fifth project is out of the view at the upper right.

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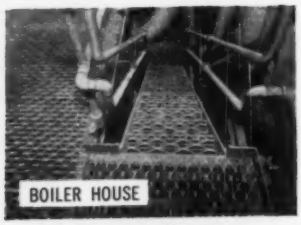

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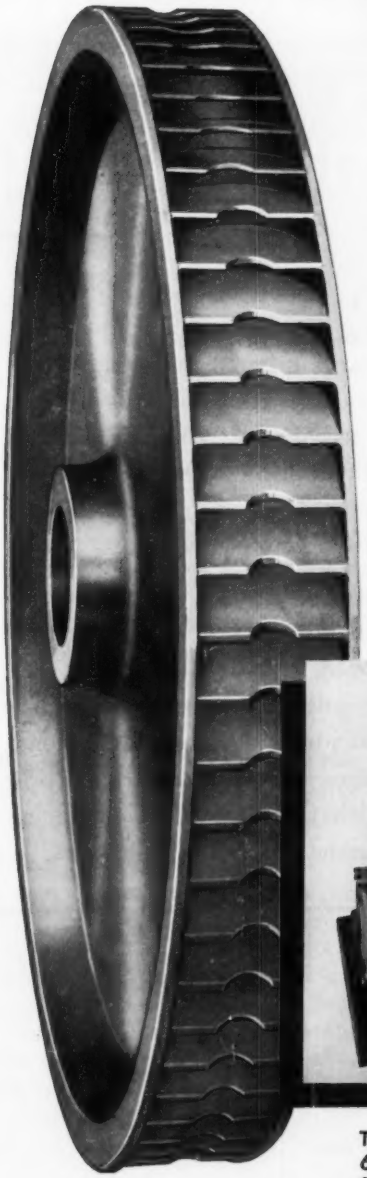

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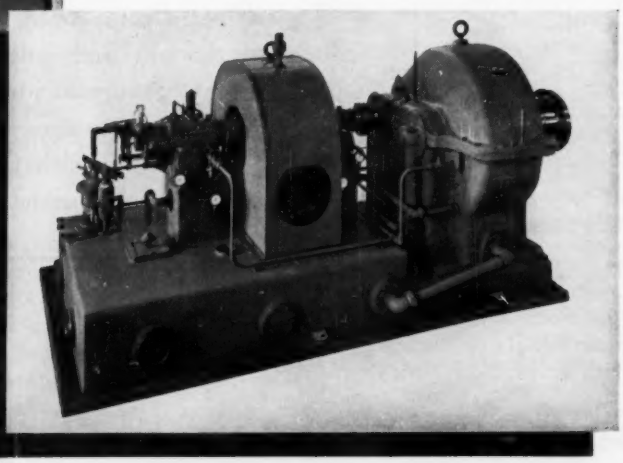

This Terry solid-wheel turbo-geared unit is rated 600 hp, 4000/650 rpm for 820 psi, 825°F steam with 275 psi back pressure.

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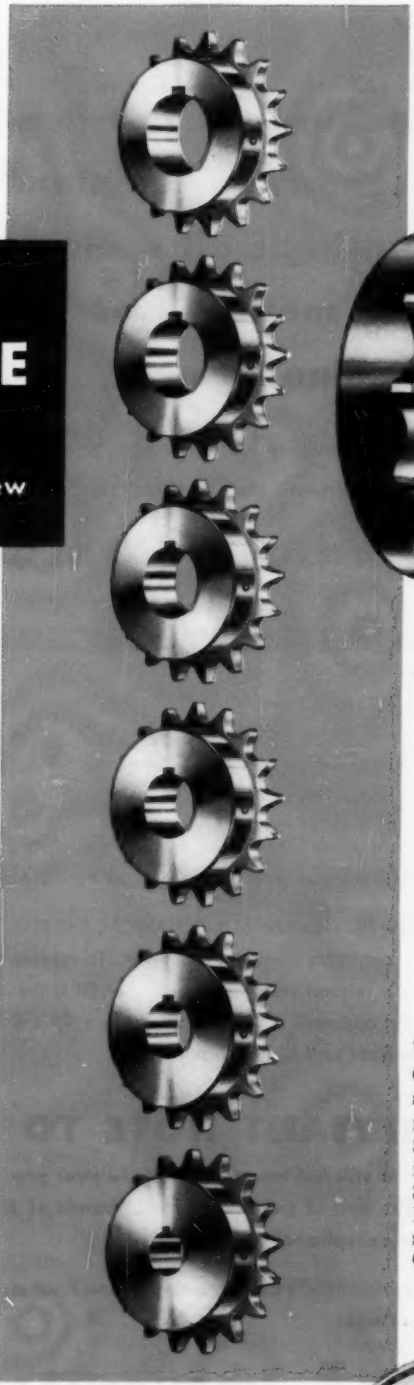
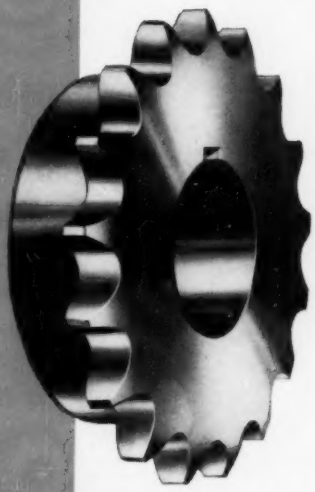


76 TOOTH SIZES
321 STOCK BORES



"OFF-THE-SHELF" — AT FACTORY PRICES

FINISH BORED – READY TO INSTALL Single width steel sprockets ⅜" Pitch through 1" Pitch—in 76 commonly used Tooth Sizes —with a full selection of finished bore diameters for each sprocket—complete with keyway and setscrew.

ELIMINATE BORING EXPENSE You save expense of reboring, keyway cutting, drilling and tapping for setscrew—and avoid downtime in emergency replacements.

BOSTON GEAR QUALITY Sets the standard for precision and performance—assures longer service life for both sprockets and chain.

OFF-THE-SHELF DELIVERY More than 100 BOSTON Gear Distributors can supply BORED-TO-SIZE Sprockets from stock. Get complete information, on any question of sprocket selection or application, from factory-trained specialists . . . at the Distributor near you. Boston Gear Works, 66 Hayward St., Quincy 71, Mass.

The BOSTON Gear complete line provides any Sprockets you need including SHOLD-A-GRIP interchangeable tapered Sprockets and Bushings. For complete listings, see BOSTON Gear Catalog No. 56.

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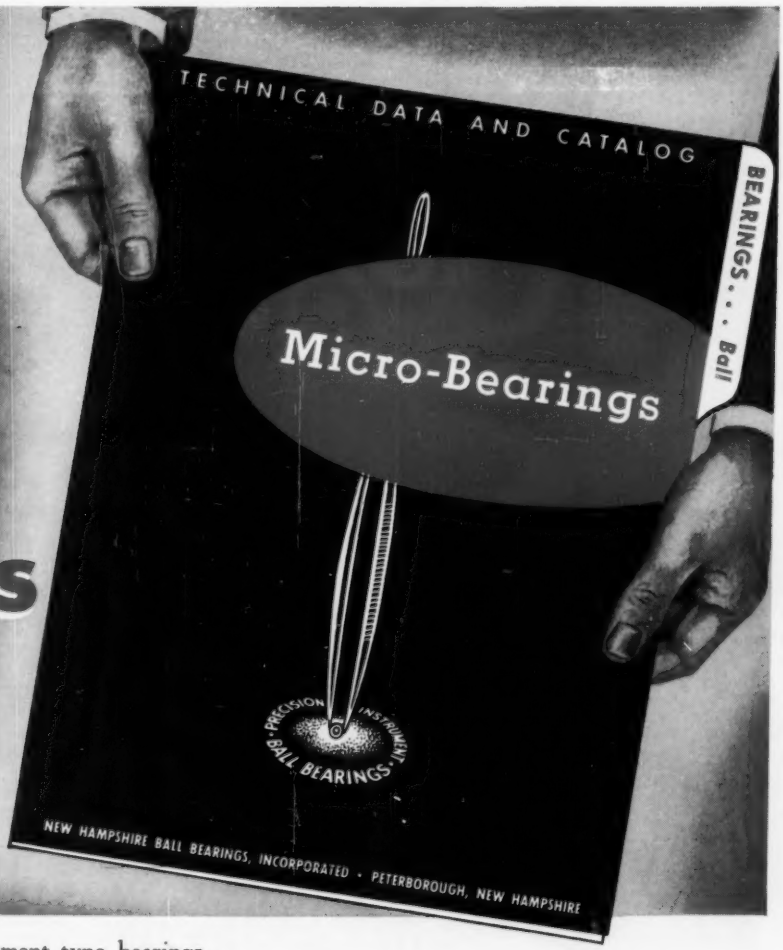
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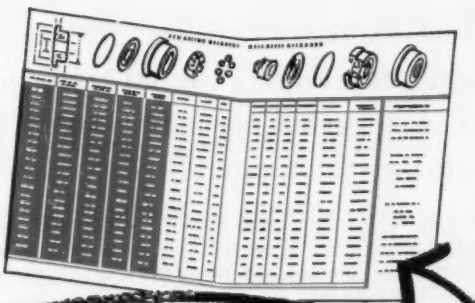

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NEW HAMPSHIRE BALL BEARINGS, INC., PETERBOROUGH, NEW HAMPSHIRE

HOW Formica IMPROVED FABRICATED PART PERFORMANCE AND SAVED 23%!

Formica studied performance requirements, developed a special grade, produced a better part, and saved the customer 52c a pound.

Are you buying laminated plastic properties you don't need? Or are you paying the penalty of poor product performance because you've been short-changed on essential properties?

You can never be sure until you have a Formica fabricating engineer check your performance requirements. Tell him what you need, where and how you'll be using your fabricated part. Then he'll select the *one grade* that's best and most economical for you.

With 52 standard grades, and a competent research staff to develop special new ones, there's never any compromise with grade selection at Formica. And design modifications recommended by Formica fabricating engineers will further help to produce a better part, frequently at big savings.

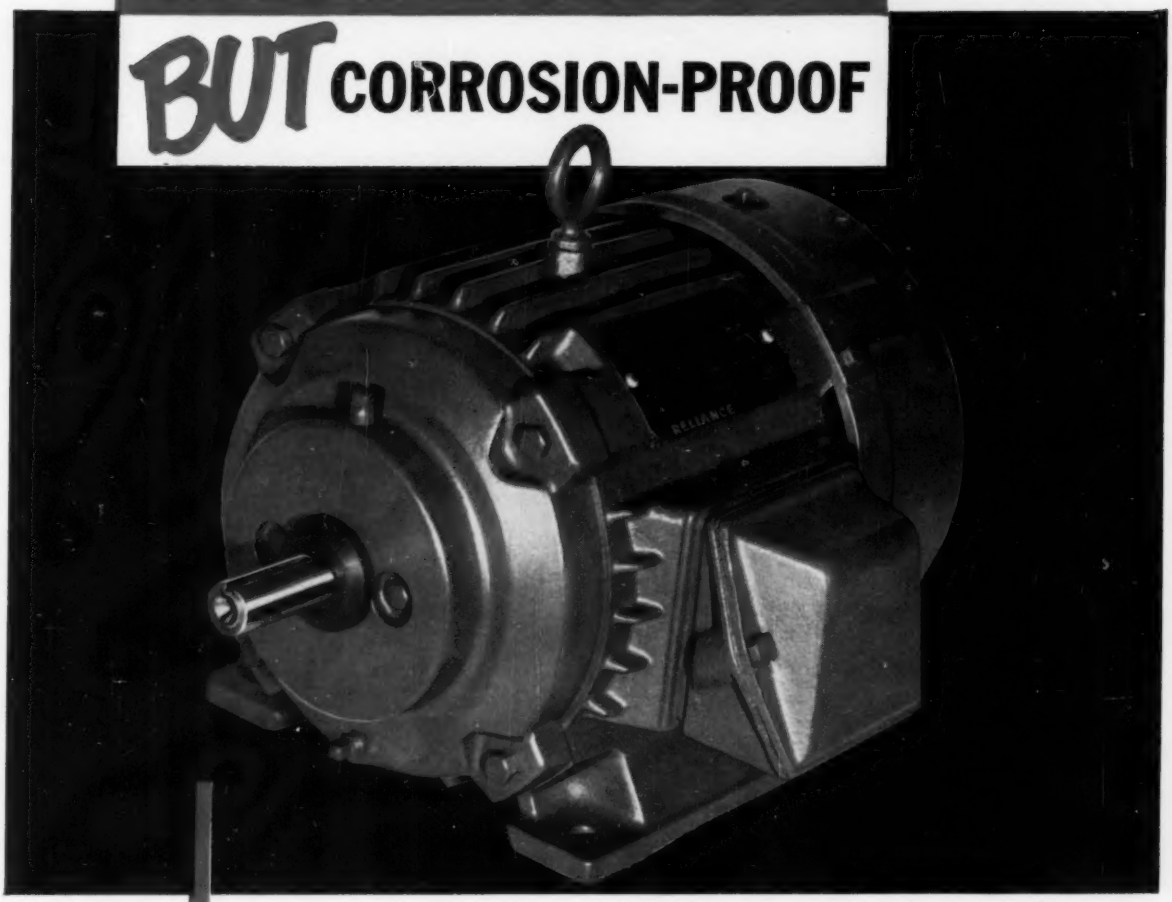
This fabricating service is part of Formica-4, designed to give you the best grade at lowest cost for your application. Call your Formica district office or send us your blueprints and your performance requirements. Formica Corporation, subsidiary of American Cyanamid, 4611 Spring Grove Ave., Cincinnati 32, Ohio.

Your *blueprint* tells only *half* the story . . .

. . . tell us your performance requirements and we'll save you money

Not Just CORROSION-RESISTANT

BUT CORROSION-PROOF



Corrosion resistance is not enough to stop acids or alkalies from chewing up a motor in a hurry. That is why the wise engineer selects Reliance Corrosion-Proof Motors for corrosive service.

These motors are built to withstand the onslaught of destructive chemicals for years. Housings are made of virtually indestructible cast iron. Exterior contours are designed to slough off liquids—no nooks and crannies to retain corrosive elements. Enclosures are sealed to prevent any leakage . . . Metermatic lubrication systems provide complete protection against burned out bearings and contaminated lubricants.

Anyway you look at them, Reliance Corrosion-Proof Motors can take it—and you're not limited in the choice of motors either. A complete line of a-c. motors, 1 thru 300 hp., is available in all mountings, frequencies and voltages.

Why not call your Reliance representative today and get all the details.

B-1585

RELIANCE Totally-Protected MOTORS

RELIANCE ELECTRIC AND ENGINEERING CO.

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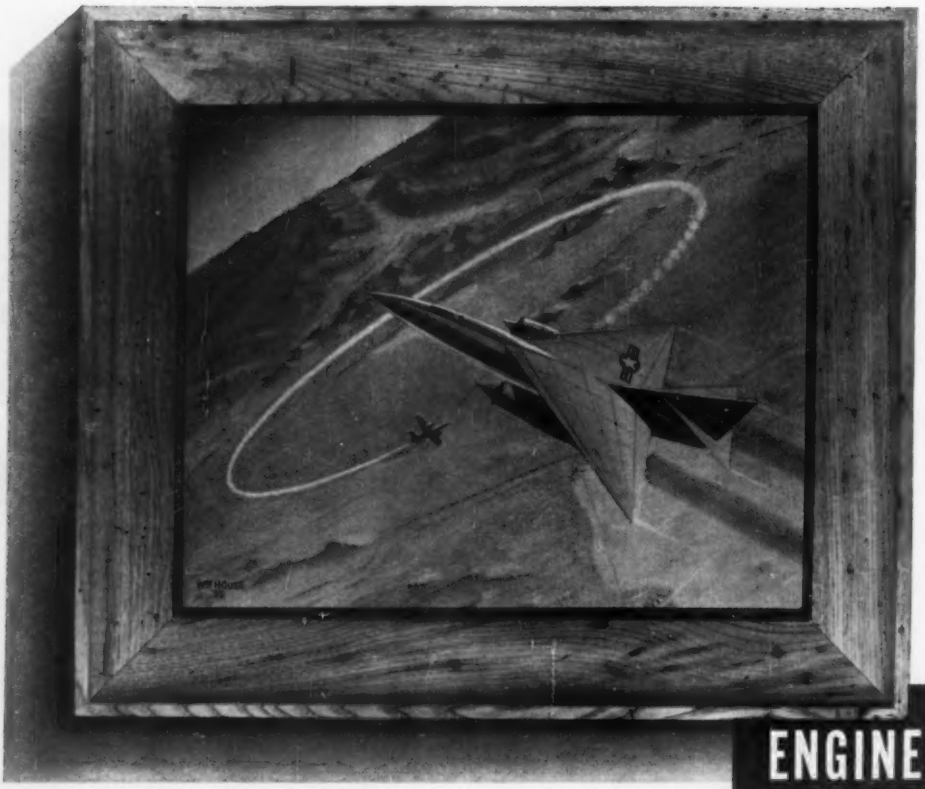
CANADIAN DIVISION: WELLAND, ONTARIO



The art of rocketry

The portraits of tomorrow's propulsion systems are rapidly becoming realities at Aerojet-General. America's foremost manufacturer of rocket powerplants, Aerojet is a major contributor to this nation's most critical rocket and missile programs.

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Your resume will receive immediate, confidential attention.

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MORE POWER FOR AIR POWER

Stroboscopic Light

for the design of Better Turbine Blades

The control of the complex vibrations of large turbine blades and parts is one of the most difficult problems facing the steam-turbine designer. Careful, thorough design is needed if these rapidly moving elements are to operate satisfactorily at extremely high pressures and temperatures for a normal life expectancy of 20 to 30 years.

At the Westinghouse Electric Corporation, engineers have found the General Radio Strobotac and Strobolux a considerable aid in studying the vibration-damping characteristics of turbine material. An electromagnetic exciter maintains a sample bar in vibration, while stroboscopic light produces a stationary image. The bar's vibration amplitude can then be accurately measured with a microscope.

High intensity, short-duration flashes of stroboscopic light make possible *detailed visual observation* of the vibratory deflection patterns in "*slow motion*". Because stroboscopic light does not in any way affect the vibration performance or other characteristics of the test specimen, this technique has proven invaluable in the development of blades for turbines of all types.

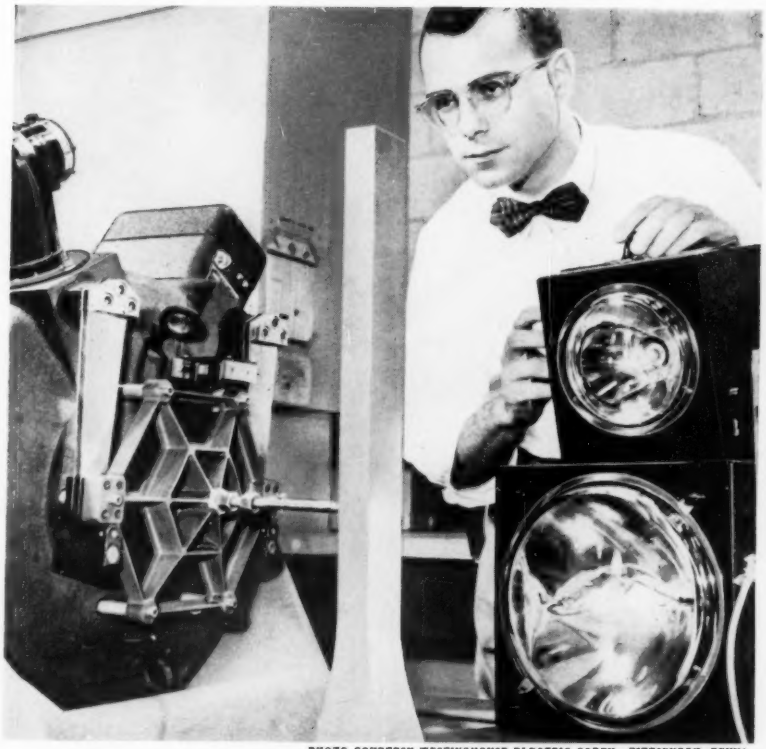
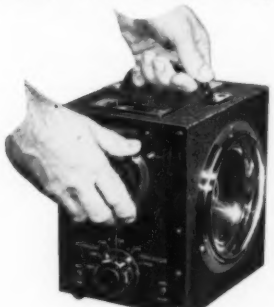


PHOTO COURTESY WESTINGHOUSE ELECTRIC CORPN., PITTSBURGH, PENNA.

Stroboscopic light has a wide field of application. This versatile tool can be applied to a wide variety of mechanical and electromechanical problems. General Radio Stroboscopic Instruments have been used to detect resonant modes in equipment to be mounted in aircraft and to inspect armatures and other moving parts of high-speed rotating machinery. Other uses include detailed examinations of the operation of . . . governors and automotive fuel-injection devices, office dictating equipment, pumps and fans in air-conditioning equipment, cloth-cutting and envelope-folding machinery, centrifuges used in forming jet-engine rings, magnetic-tape systems in high-speed computers, phonograph and other small instrument and timing motors.

Clear, stationary images of rapidly moving objects are produced with the aid of the G-R Strobotac . . . Strobolux . . . or Strobolume . . . where it is impossible to see this movement with the unaided eye. For this reason, these instruments are used in a wide variety of work. Leading manufacturers have found this equipment indispensable in research, production-testing and maintenance work of all kinds.



Type 631-BL STROBOTAC®

. . . self-contained, portable, operates from 115-v, 60 cycles . . . basic stroboscope unit for visual examination of rapidly moving parts and mechanisms and for use as a versatile tachometer for speed measurements . . . direct-reading range of flash repetition rate is 60 to 14,400 rpm; instrument will "stop" motion to 100,000 rpm . . . **Price $155.**

Type 648-A STROBOLUX®

. . . produces light intensity 100 times that of Strobotac . . . flash-rate up to 6000 per minute . . . operates from Strobotac . . . **Price $235.**

Type 1532-B STROBOLUME

. . . high intensity illumination 500 times that of Strobotac . . . flash rate up to 1200 per minute, up to 3000 per minute at reduced intensity . . . flash rate controlled by Strobotac, G-R Contactor, or "homemade" make-break mechanism . . . **Price $265.**

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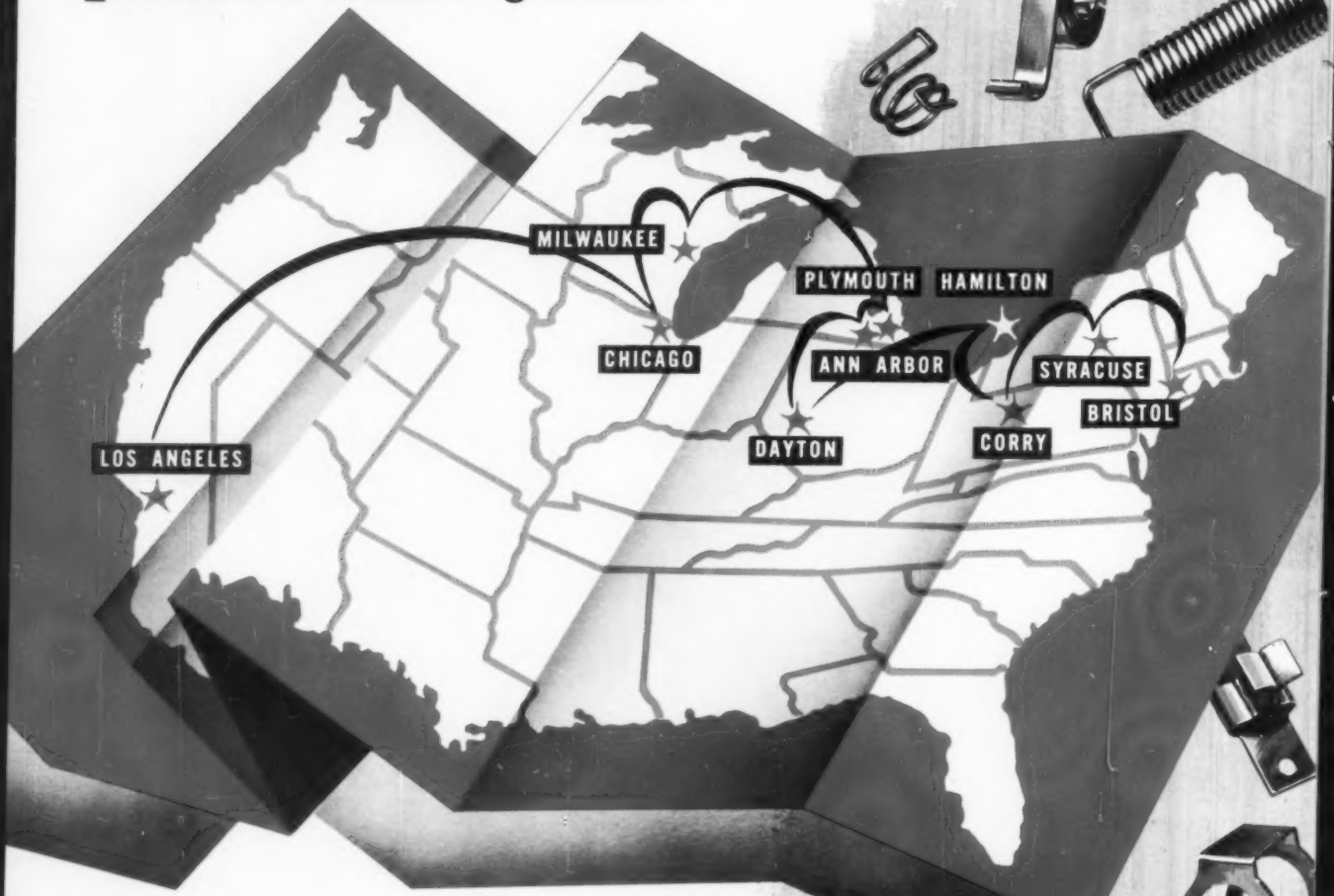
920 S. Michigan Ave. **CHICAGO 5** 1000 N. Seward St. **LOS ANGELES 38**

G-R Stroboscopic Instruments can help you. There's use for them wherever there are moving parts or mechanisms and repetitive operations of any kind, and that includes just about every plant. Write for the G-R Stroboscope Bulletin.

The No. 1 ROUTE

...To Spring Satisfaction passes near you...



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making available to bustling industrial areas a vast pool of integrated skill and research—through separate, complete operating Divisions. Factory-trained sales and engineering field men. Design literature available on all types of springs.

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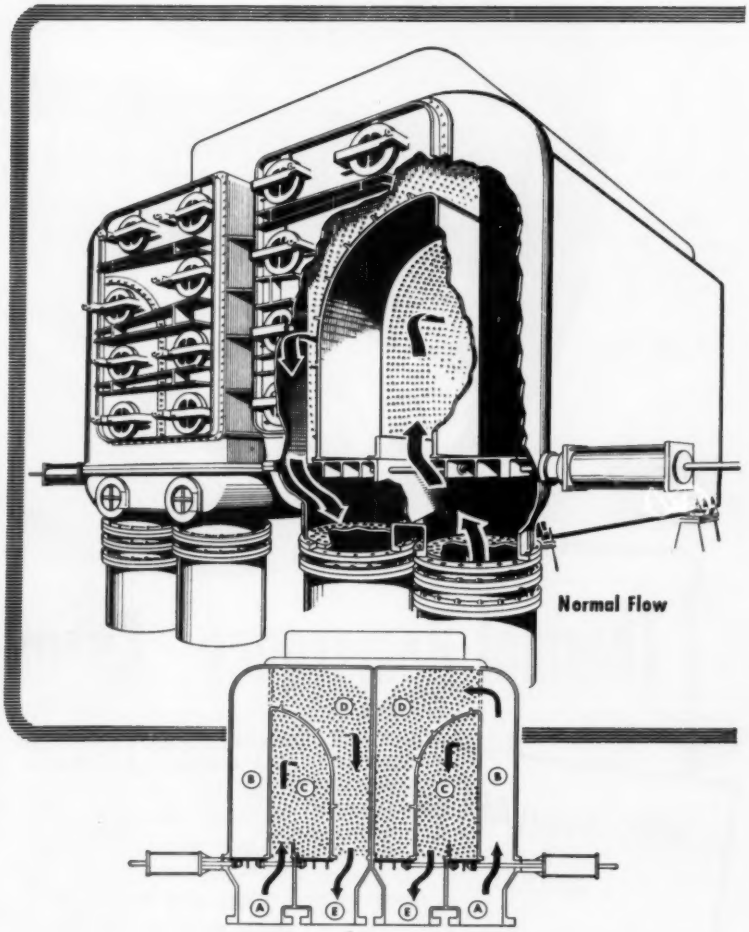
REVERSE FLOW by C. H. WHEELER
Cleans Steam Condenser Tube Sheets Without Loss of Load

When debris and organic growth collect on the tube sheets of a C. H. Wheeler Patented Reverse Flow Steam Condenser, you don't have to shut it down for cleaning. It cleans itself—without loss of load. Sluice gates arranged within the condenser may be controlled, either electrically or hydraulically, to reverse the flow of cooling water through the tubes. This sudden reverse flow literally flushes away leaves and debris, dislodges crustaceous matter from clogged tubes.

Because of 100% water flow during back flushing, there is only a negligible dip in vacuum momentarily, thus permitting continuous load on the turbine The Reverse Flow Condenser cleans itself in minutes, compared with hours of downtime when tube sheets are manually cleaned. A typical report shows a half-inch loss of vacuum (due to fouled tubes and tube sheets) was restored in five minutes after reversing the flow of cooling water. Often, a C. H. Wheeler Reverse Flow Condenser goes two years or more without shut down for cleaning, depending on the condition of the cooling water.

New, exclusive deaerating features and construction techniques help make C. H. Wheeler Steam Condensers "First in Efficiency." Let C. H. Wheeler Custom Engineer your next steam condenser. Phone or write C. H. Wheeler Manufacturing Co., 19th & Lehigh, Philadelphia 32, Pa. . . . Manufacturers of Steam Power Plant Condensers • Vacuum Equipment • Marine Auxiliary Machinery • Water Supply, Drainage and Circulating Pumps.



HOW "REVERSE FLOW" WORKS

Left Side Shows Normal Operation

Water enters inlet A with right port open. Flows through tube bank C to rear of condenser . . . returns through tube bank D to front of condenser and discharges at E.

Right Side Shows Reverse Flow

Sluice gates move on a common stem. Water flows up through channel B, and through tube bank D to rear of condenser . . . returns through tube bank C to front of condenser.

In the C. H. Wheeler Divided Water Box Design, each half of the condenser can be back-flushed independently.

WE603

C.H. Wheeler OF PHILADELPHIA

NEW

AMERICAN offers SYNTHETIC FELTS

Thermal Resistance...Chemical Resistance!

NOW AVAILABLE!

- DACRON
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Send today for fact sheets!

Now, American, through its technical research, has perfected the mechanical interlocking of the man-made fibers listed at the left, to produce three-dimensional felt structures.

These new Felts have exceptional *chemical resistance* with *thermal stability* to 300 F. They are non-hygroscopic, biologically stable and are available in a complete range of thicknesses. Precision engineering assures close density and thickness control.

The properties which characterize these new Felts are being utilized in filtration—laminated plastics as reinforcing material—high temperature bearing seals—gasketing. In fact, end uses are unlimited!

American's engineering and research staff is prepared to supply you with complete data and product recommendations.

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American Felt Company

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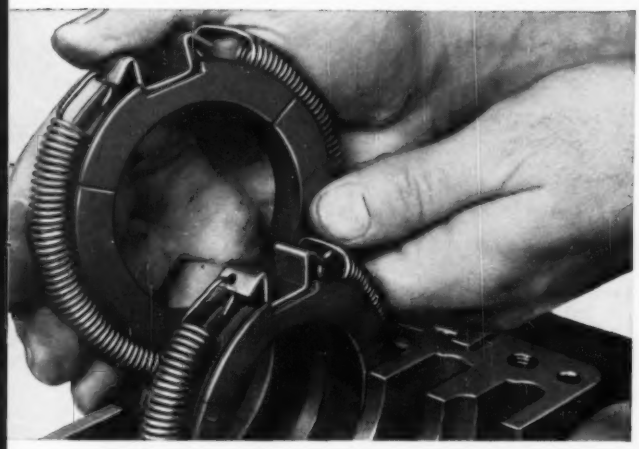
On all General Electric High-speed Turbines,

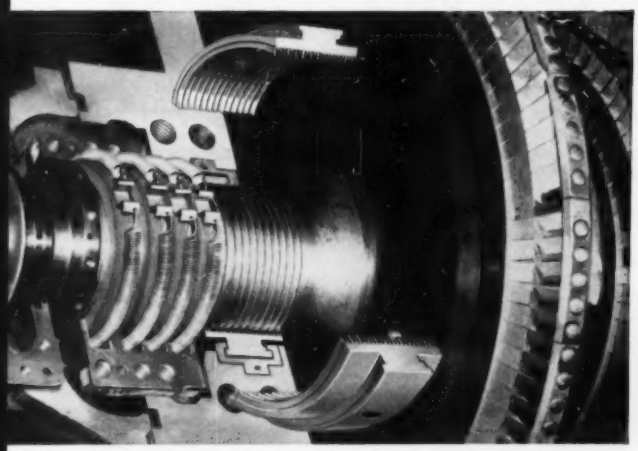
Well-designed, efficient seals...



Highly efficient, easily-replaced carbon packings

For the most effective shaft-end sealing, well-designed, low-cost carbon packings are used on G-E High-speed Turbines to seal steam pressures up to 75 psig. Made of non-galling, self-lubricating carbon-graphite, these segmental rings have high mechanical strength in the small sizes used, assuring long life under normal operating conditions. A garter spring in an offset "V" groove holds each ring together and presses it firmly against the side of the chamber, forming a tight seal. This unique arrangement permits the rings to support their own weight and to adjust themselves to the shaft position, thereby reducing wear and increasing the life of the seal. The rings are contained in compact external packing boxes, and can be easily inspected or replaced without breaking the horizontal joint of the wheel casing.

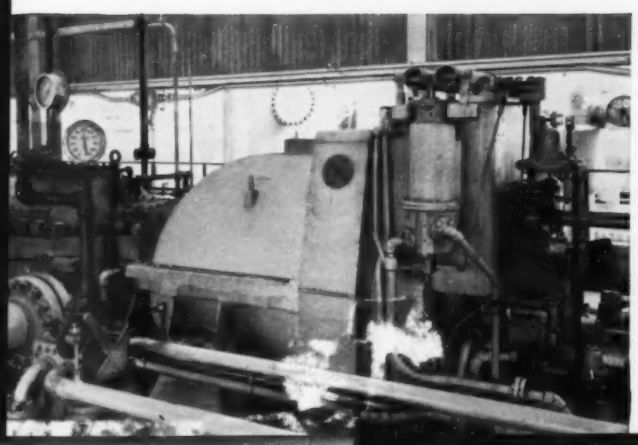
cut steam leakage...



Reliable, long-life metallic-labyrinth seals

To effectively minimize shaft-end steam leakage where shell pressures exceed 75 psig, segmental, high-low tooth metallic-labyrinth seals are used in combination with carbon packing. Between stages, straight-tooth metallic-labyrinth seals are always used. For maximum seal efficiency, minimum clearances between the teeth and the shaft are maintained by precision-machined hook fits in the packing housing. Shaft scoring is practically eliminated since the leaded-bronze segments are spring-backed and can move outward should there be accidental contact with the shaft. When unbalanced steam pressure forces axial movement of the seals, the shoulders of the rings and the housing engage to form a tight steam seal. All labyrinth seals are designed to compensate for thermal expansion, thus assuring a most efficient steam seal at operating temperatures.

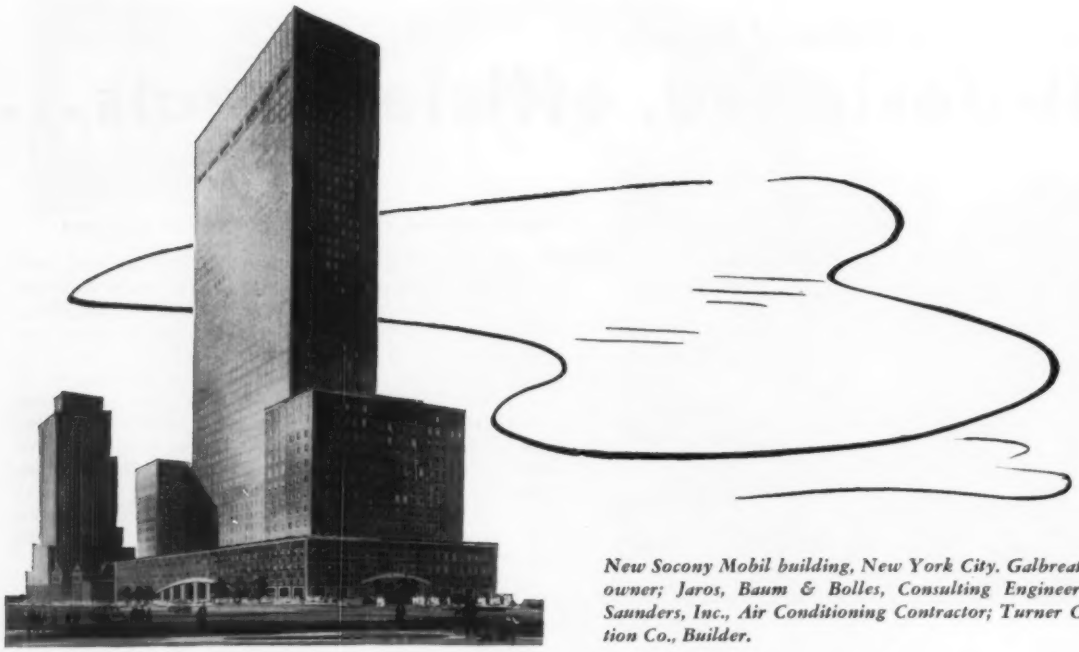
reduce maintenance costs



The careful design and manufacture of these steam seals is your further assurance of low maintenance and consistent reliability of G-E High-speed Turbines. Why not check into the many other sound design features built into these mechanical drives? Your Apparatus Sales Representative will be glad to explain the many benefits they offer to your operation. Contact him for further information or write for Bulletin GEA-6232, General Electric Company, Section 241-7. Schenectady, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

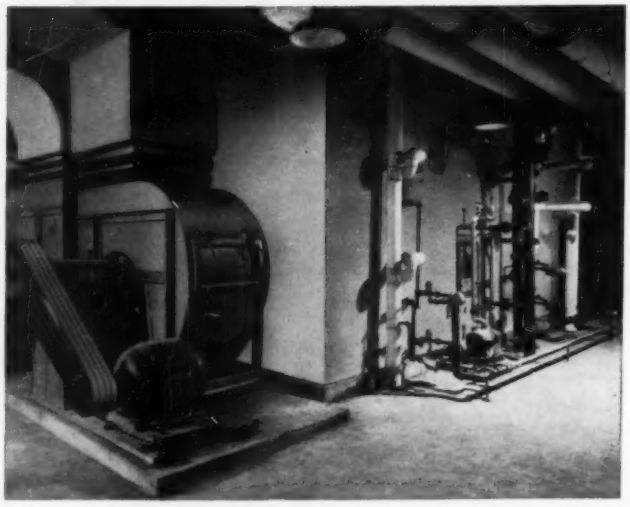


New Socony Mobil building, New York City. Galbreath Corp., owner; Jaros, Baum & Bolles, Consulting Engineer; Kerby Saunders, Inc., Air Conditioning Contractor; Turner Construction Co., Builder.

WORLD'S LARGEST AIR CONDITIONED COMMERCIAL OFFICE BUILDING USES 75 FANS, 22 CONDITIONING UNITS BY "BUFFALO"

A new landmark at Lexington and 42nd St., New York, the Socony Mobil building is a model for office buildings of the future. It is the largest fully air conditioned commercial office building in the world — the largest built in New York in a quarter-century. Offering so much to tenants, it is little wonder that its 1,300,000 square feet were virtually 100% rented before completion.

Selection of "Buffalo" for all the fans and many of the conditioning units reflects the confidence which engineers, owners and contractors have placed in "Buffalo" for the past 79 years. You will find "Buffalo" air handling equipment in outstanding plants, hotels, institutions, stores and public buildings throughout this hemisphere. And everywhere, you will find it performing to satisfaction, because "Buffalo" builds the "Q" Factor* of Quality into every unit. If you have a job for air, write "Buffalo" into the plans to insure the results you want.



"Buffalo" Type BL Fans handle air in Socony Mobil building. These fans (some of them 13 feet high) plus "Buffalo" Axial Flow Fans and "Buffalo" Shortboy Ventilation Units move all the air. PCLW Dehumidifiers, Humidifiers and PC Air Conditioning Cabinets process the air for various zones.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

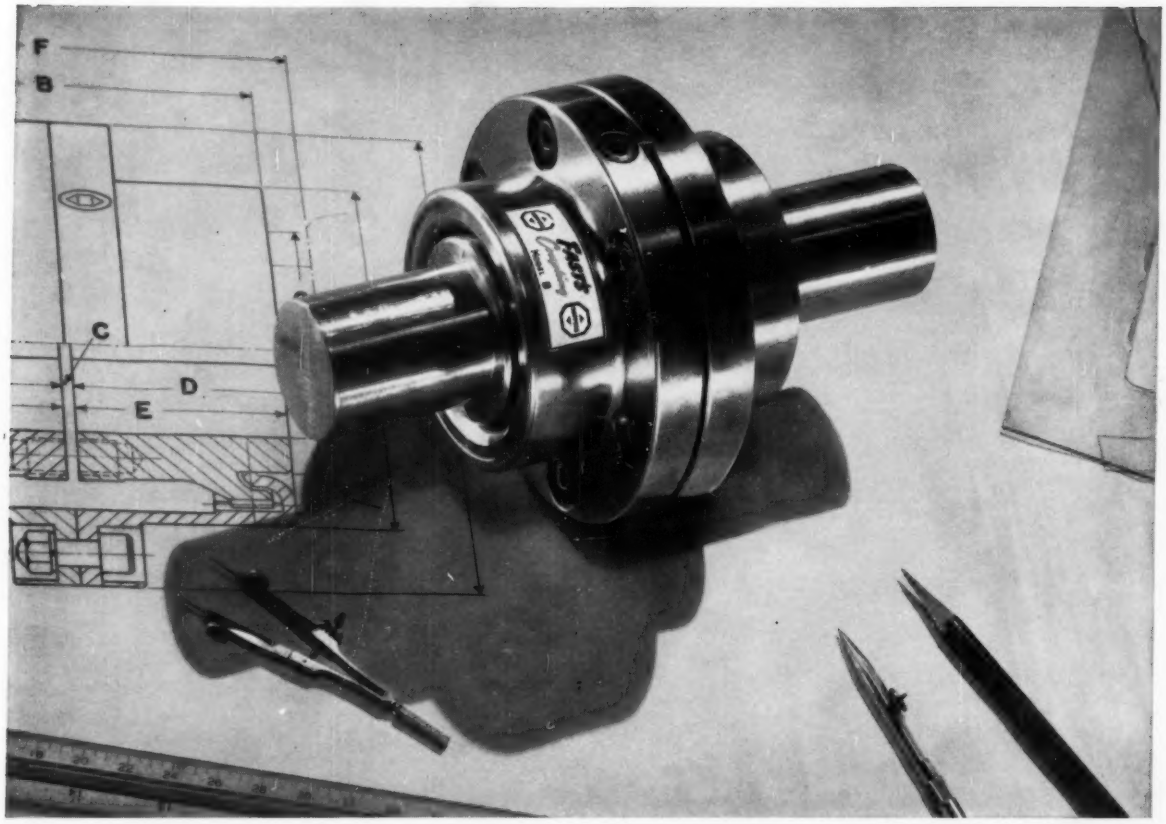
"Buffalo"

BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING



Now for the first time, a Fast's Coupling for light and medium drives—at a new low cost!

It's the new Fast's Coupling MODEL B—a lighter, smaller coupling with all the famous Fast's features never before available at such a low cost!

The new MODEL B fills the needs of manufacturers of fans, blowers, pumps and other light-to-medium drive units where coupling *cost* is as important as performance. Koppers engineers designed it to eliminate the cost barrier and offer Fast's rugged design and trouble-free performance for hundreds of new applications.

All steel, dust and moisture proof with metal-to-metal seal, Fast's MODEL B is available for shaft sizes up to $2\frac{5}{8}$". Like all Fast's Couplings, it's *sold with service* . . . Koppers *free* engineering service that guarantees the right coupling for the job.

The new Fast's MODEL B Coupling may offer a profitable solution to your light or medium drive coupling problems. Find out how by writing for full details to: KOPPERS COMPANY, INC., Fast's Coupling Dept., 3406 Scott St., Baltimore 3, Md.

THE ORIGINAL **FAST'S Couplings**

KOPPERS

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE, MD. This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Koppers Electrostatic Precipitators, Aeromaster Fans and Gas Apparatus. *Engineered* Products Sold with *Service*

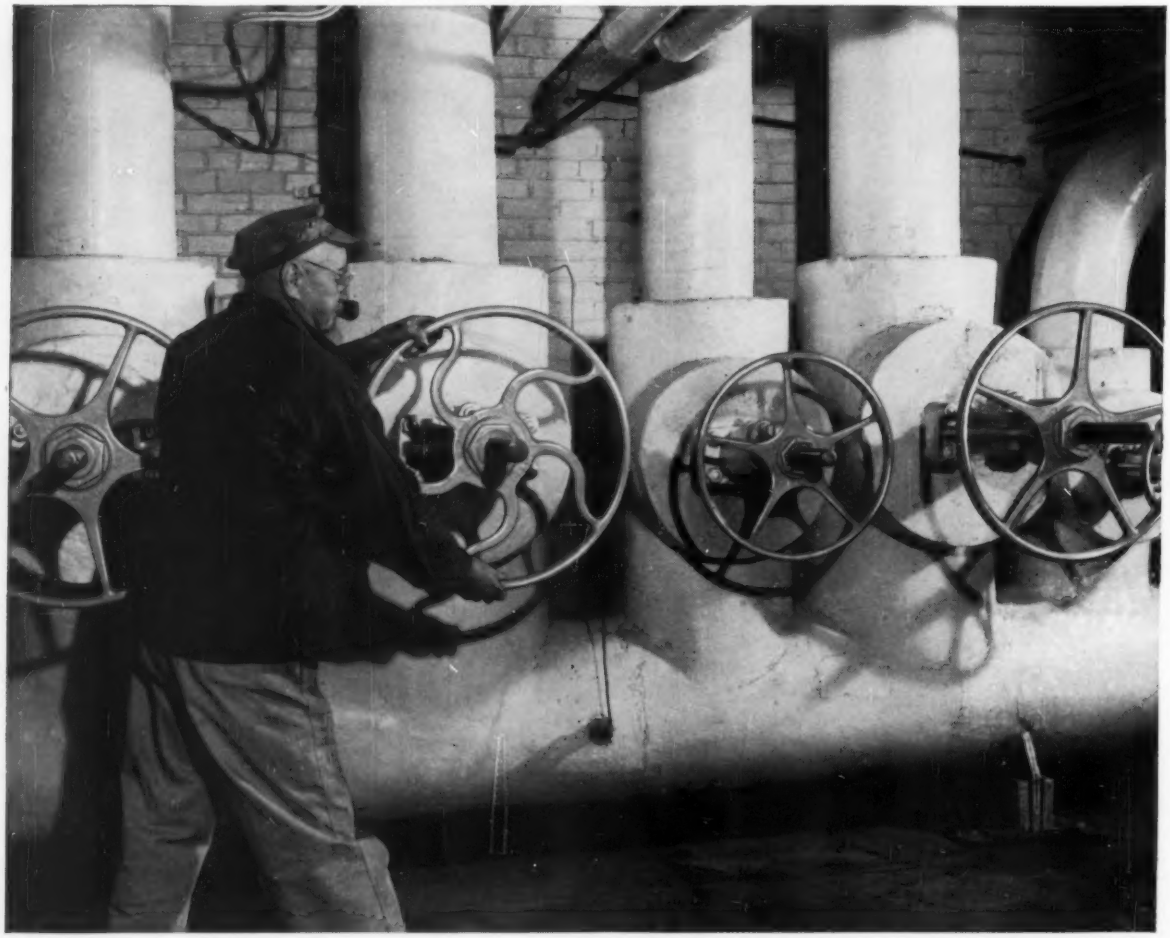
KOPPERS COMPANY, INC., *Fast's Coupling Dept., 3406 Scott St., Baltimore 3, Md.*
Gentlemen: Please send me more detailed information on the new Fast's Coupling MODEL B.

Name.....

Company.....

Address.....

City.....Zone.....State.....



20-year veterans—all—
with Crane "one-cost" service records

A CASE HISTORY—What better hedge could a power plant have against high maintenance costs?

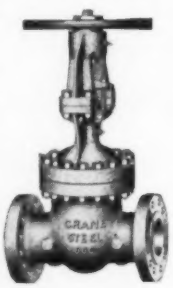
Call it foresight or sound buying practice, the Fort Bend Utilities Co., Sugar Land, Texas, knows the bigger value in quality steel valves. For 20 years now, these Crane 600-pound gates have been operating with no added cost beyond original investment, except for occasional repacking.

The valves are on a main header, with working pressure at 400 psi, 750 deg. F.

As a subsidiary of Imperial Sugar Co., the Fort Bend Utilities plant supplies steam to the neighboring Imperial Sugar refinery through the valve shown being operated. This 8-in. Crane No. 76XR steel gate has to its credit 20 years of faithful once-a-week operation with the refinery's weekend shutdowns. The other valves assure dependable steam control to units in the power plant.

Service records like this result from internal valve quality. They begin with the greater care Crane gives to design, castings, heat treating and machining.

Don't be misled by outside similarity to Crane steel valves. Get the facts from your local Crane Representative or by writing to address below.



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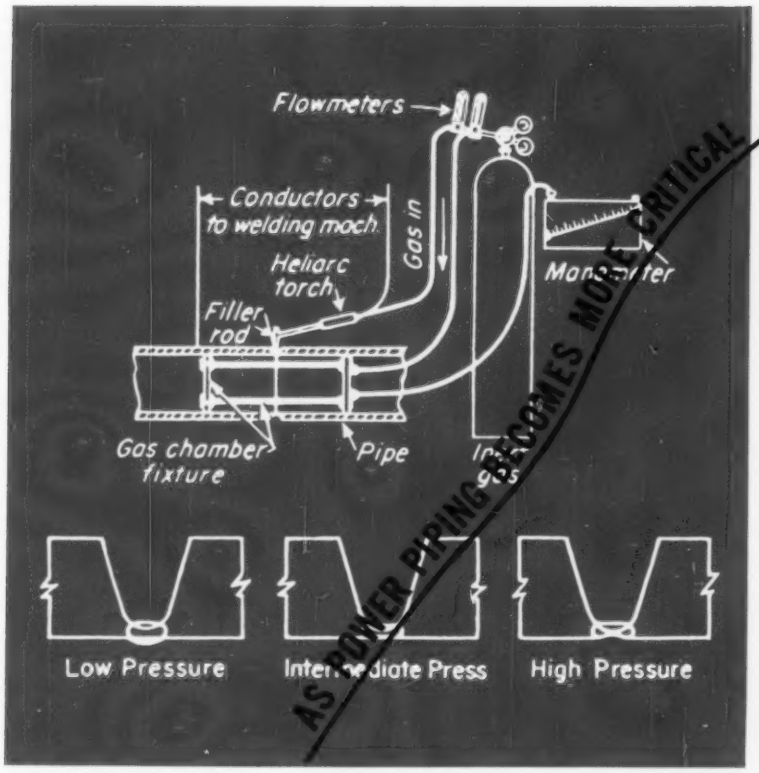

KELLOGG'S FIELD WELDING TECHNIQUES KEEP PACE

With main and reheat steam piping for steam-electric power plants becoming heavier and more difficult to handle because of increasing wall thicknesses, more and more of the welding previously done in fabricators' shops must be handled in the field. This, coupled with the need for still better welding techniques to combat higher operating pressures and temperatures, demands even higher standards of design and workmanship to compensate for the less favorable conditions often encountered in the field.

One way in which M. W. Kellogg sets the pace in field fabrication is with K-Weld*—Kellogg's unique inert gas shielded technique of arc welding. With K-Weld, complete penetration and a highly uniform internal contour are assured without the use of backing rings. Incorporating a Kellogg development which controls internal gas pressure and shape of the interior weld surface automatically, K-Weld is recognized as the ultimate in welding techniques for any type or size of alloy piping—both for shop and field fabrication.

A 12-page booklet, "For The Modern Central Power Station," describes K-Weld and other M. W. Kellogg facilities for the design, fabrication, installation, and testing of main and reheat steam piping.

K-Weld root bead is laid while the pipe interior is under controlled inert gas pressure in the gas chamber fixture. Diagram at top of page shows detail of this portable gas chamber fixture and how interior weld surface is controlled by varying pressure.

K-Weld is always under the supervision of a Kellogg inspector, supplementing final radiographic inspection. In addition, a permanent chart record is made on the potentiometer of all steps in welding and stress relieving.

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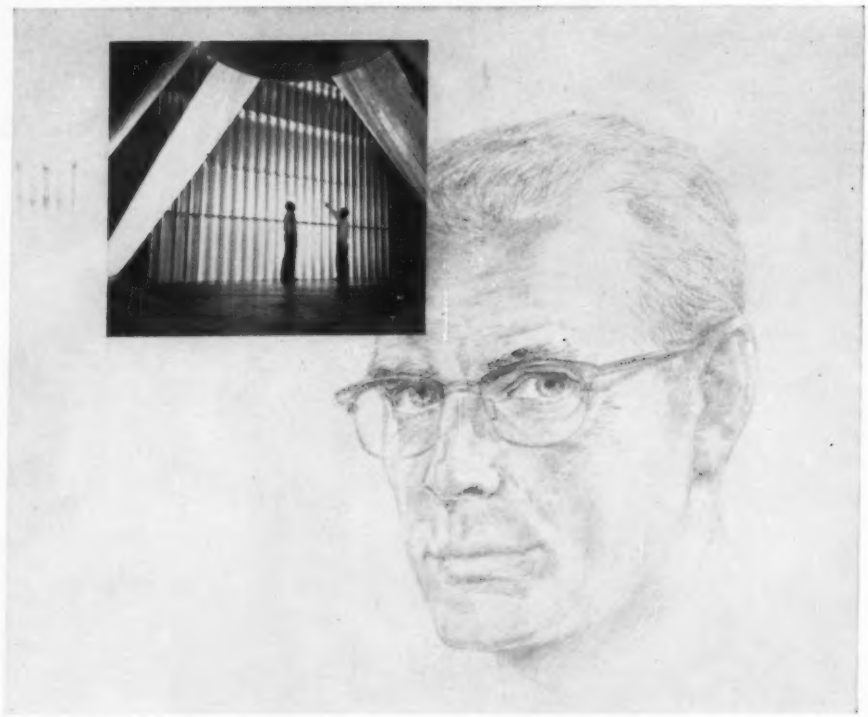
POWER PIPING—THE VITAL LINK



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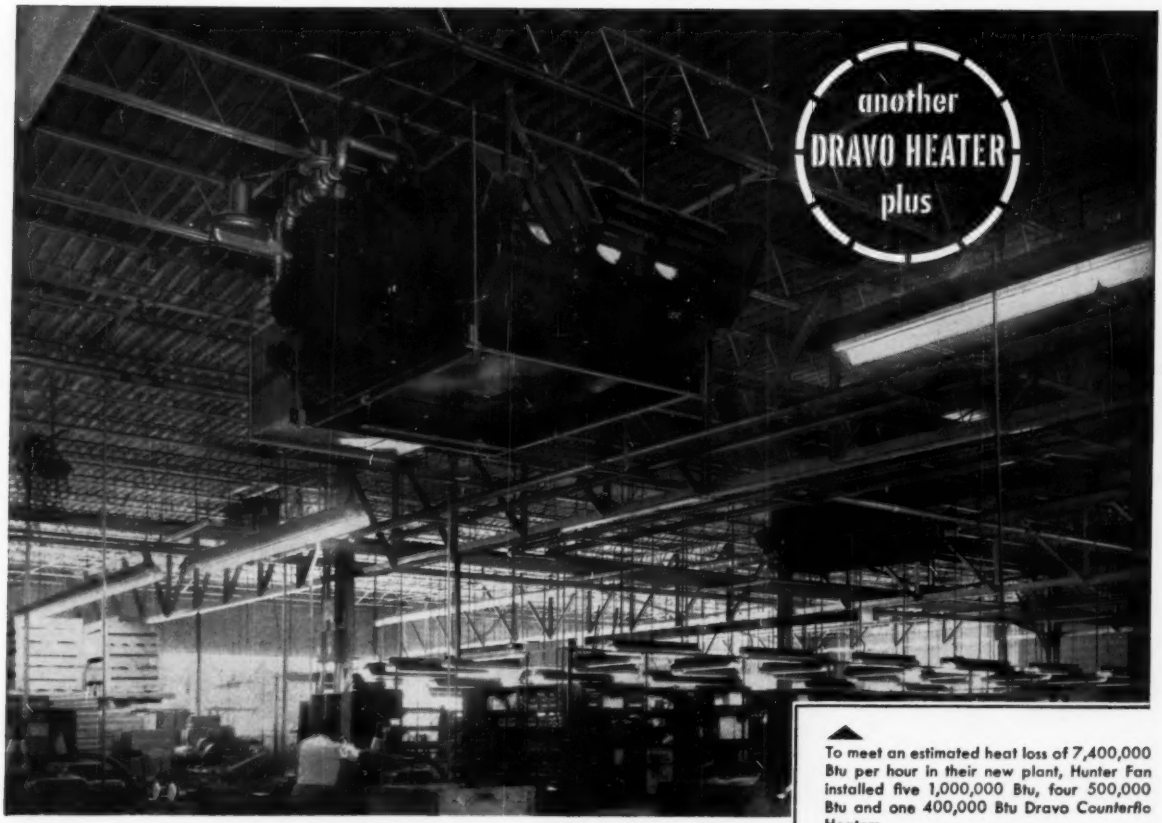

To meet an estimated heat loss of 7,400,000 Btu per hour in their new plant, Hunter Fan installed five 1,000,000 Btu, four 500,000 Btu and one 400,000 Btu Dravo *Counterflo* Heaters.

The new L-shaped factory building, 350 by 420 feet, supplies 108,000 square feet of manufacturing and storage space. Dravo Heaters meet varying heat requirements easily despite the fact that one-sixth of plant's total wall space is window area.

Southern factory finds economical answer to plant heating problem

Much of the South's rapid industrial expansion can be credited to its year-around sunny, mild climate. But this same climate has presented some unique heating problems to manufacturing firms like Hunter Fan and Ventilating Company of Memphis, Tennessee. Their particular problem was to provide an efficient yet economical heating system for their new factory building.

In addition to the normal heating requirements, experience indicated that "chill" conditions prevailed during many winter and early spring days, particularly in the morning hours. This "part time" heat requirement indicated the need for a conventional system that could not only handle their normal needs but also have sufficient flexibility to meet these varying demands. Specifically what they needed, Hunter plant engineers decided, was a system that instantaneously handled a wide variation of heat requirements and yet was low in initial cost, maintenance, and compact enough to fit limited space in modern, low factory structure.

As cooling and ventilating specialists, they examined and evaluated all types of heaters and heating systems. Ten Dravo *Counterflo* heaters were found to be the ideal answer to their plant heating requirements.

Regardless of your plant location—East, West, North or South—you'll be dollars ahead by carefully investigating Dravo's quality heaters to see how their many features work for over-all heating efficiency and economy every day of operation. The coupon below will bring you all of the details—mail it today!

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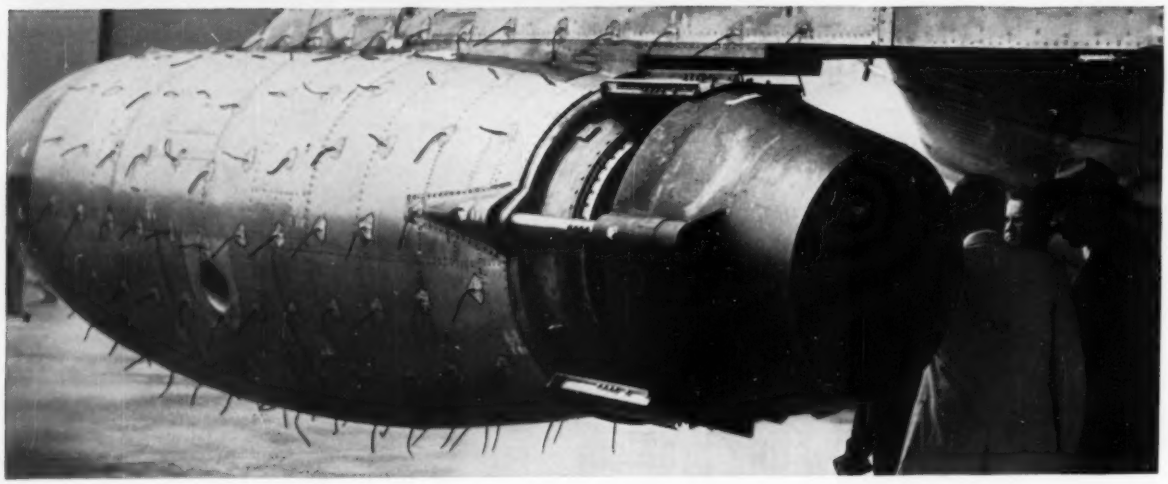

Boeing "M.E.'s" help meet two pressing jet-age problems

Boeing mechanical engineers play an important part in designing such advanced devices as the prototype sound suppressor (top) and thrust reverser (bottom), shown installed on the Boeing 707. On production 707 jet airliners, however, the two will be combined into a single unit capable of performing the duties of both the suppressor and reverser. Test results have been so satisfactory that Boeing has contracted to deliver 707s to airlines, beginning in late 1958, equipped with sound suppressor-thrust reversers.

Mechanical engineers work closely with other engineers at Boeing in design and research for the 707, the KC-135 tanker-transport, the B-52 jet bomber, the BOMARC IM-99 weapons system, and aircraft of the future. Their work is challenging, at the frontiers of knowledge in design, rocket, ram jet, and nuclear power research, structural and flight testing, stress analysis, thermo and fluid dynamics, investigating the problems of heat, compressibility, elasticity and "creep," and in many other activities.

Boeing now employs more than twice as many engineers as at the peak of World War II. But, because of steady expansion, more topnotch technical men are needed. They will work with superb facilities, including the multi-million-dollar new Boeing Flight Test Center, the latest electronic data reduction equipment, and a new wind tunnel, which will be in operation shortly, capable of velocities up to Mach 4.

Boeing engineers work in closely knit project teams. There are regular merit reviews, individual recognition and ample scope for creative expression. Engineering aides and draftsmen handle routine jobs, freeing engineers for the numerous stimulating assignments.

Life is pleasant for Boeing engineers and their families in the progressive, comfortable-size communities of Wichita and Seattle. How would you like to do interesting and vital work with one of the world's leaders in aviation? Inquire now about an opening on one of Boeing's research, design or production teams.

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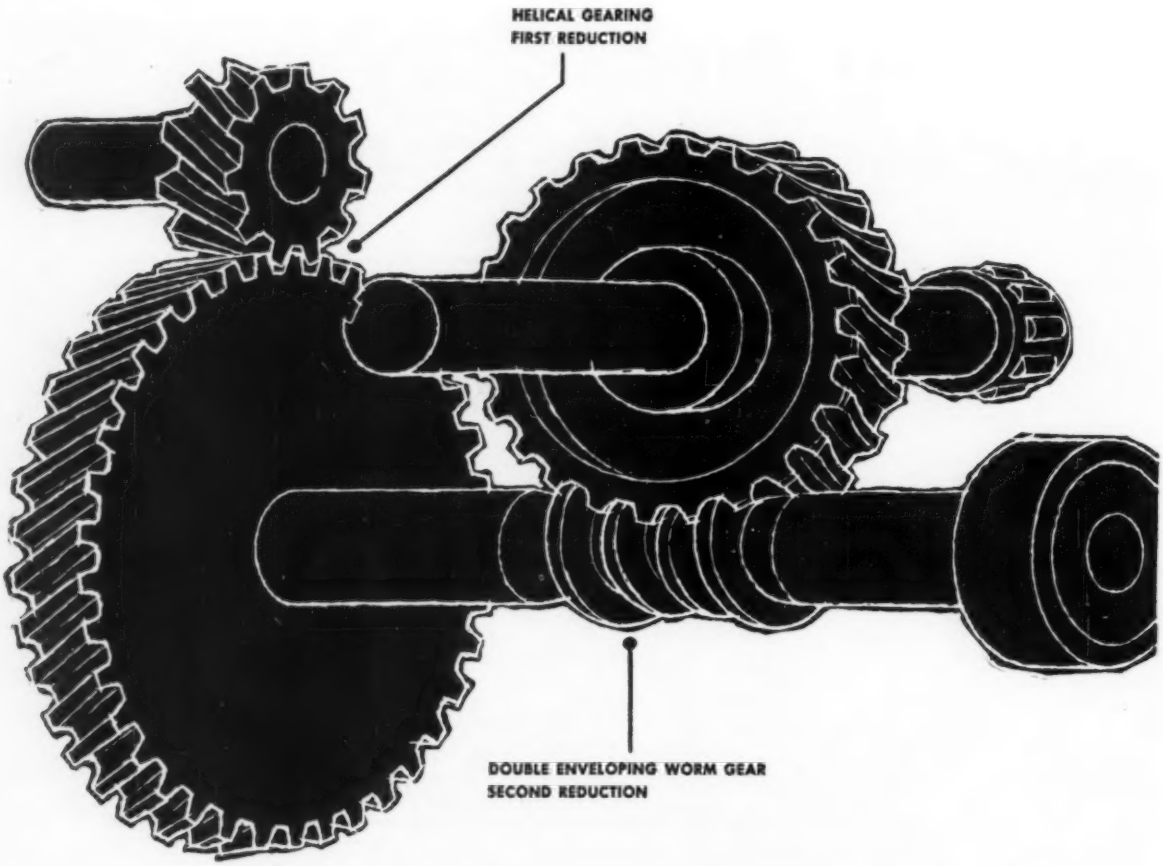

How Westinghouse new right-angle gearmotor delivers 32% more power

With this exclusive match of gearing, Westinghouse right-angle gearmotor gives you top horsepower and rugged dependability at the lowest cost. It's the result of skillful use of helical gearing to gain maximum efficiency from high lead-angle worm gearing. Over a range of speed reduction, from 20:1 to over 100:1, the Westinghouse right-angle gearmotor *averages* 32% more power than conventional single-reduction, worm gearmotors. At a ratio of 60:1 you actually get 98% more power.

Greater dependability and long life result from Westinghouse exclusive double-enveloping worm gear. It provides 330% more gear-tooth area to support the load. As wear occurs, only double-enveloping gears regenerate or reproduce themselves.

In application, Westinghouse design for high overhung load capacity requires no outboard support. Right-angle gearmotors are available in a complete range of AGMA output speeds and Life-Line® "A" motor enclosures.

FREE detailed facts about Westinghouse new right-angle gearmotor in booklet B-6579. Call your local Westinghouse Sales Office or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa.

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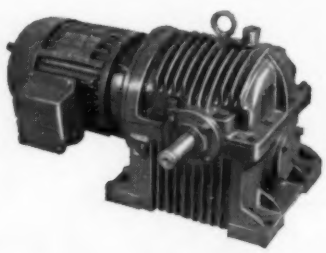

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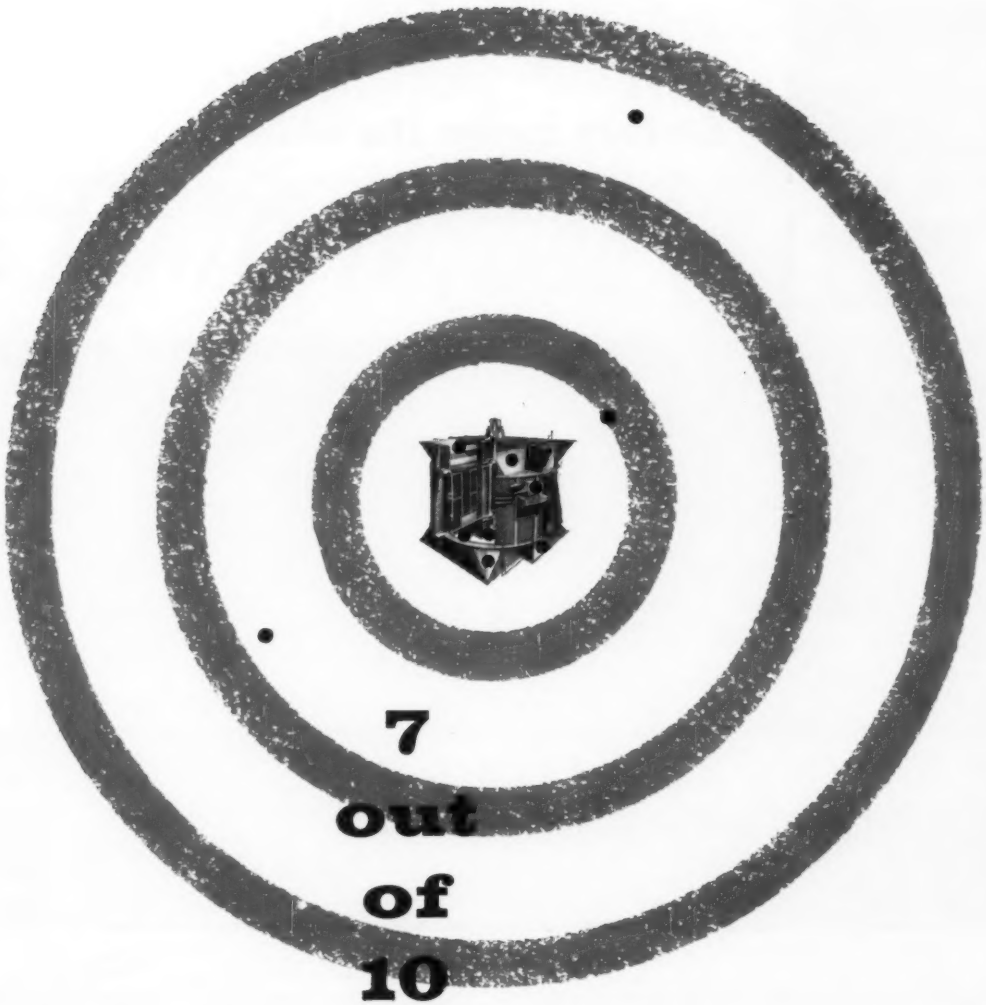

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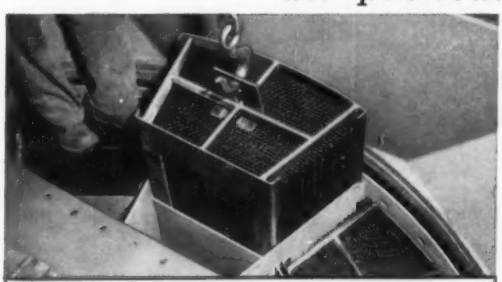

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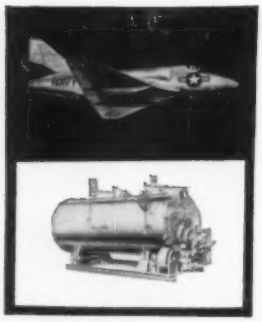

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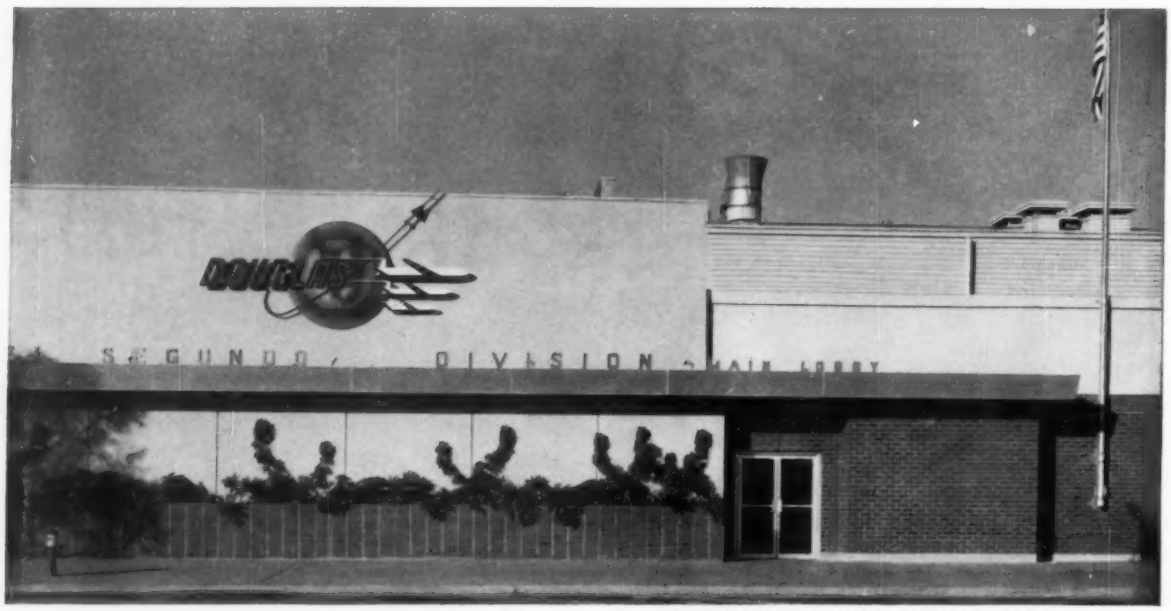

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Architect & Engineer: Holmes & Narver, Inc., Los Angeles, Calif.
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■ No one knows the importance of "cruising speed" operation in aircraft better than the Douglas Aircraft people. They know an airplane, to be efficient, to operate economically, to have longer life, must fly at "cruising speed." They know, too, there must be extra reserve power for take-off—for emergencies. So, when it came to boiler selection for the new A4D Skyhawk production facilities at their El Segundo, California Division, it was only natural they turned to Kewanee Reserve Plus Rated Boilers with 50% extra built-in power assuring "cruising speed" operation. For "cruising speed" means less strain—less wear. It means higher efficiency . . . it means lower maintenance and repair costs. Kewanee Boilers are rated on nominal capacity with reserve to take care of normal needs—meet emergencies of the present—fluctuating loads and future expansion. A boiler rated on maximum capacity, operating at constant top speed, requires more maintenance, constant attendance, and finer burner adjustment to maintain efficiency. So, choose Kewanee—for lower fuel and maintenance costs—more efficient "cruising speed" operation.

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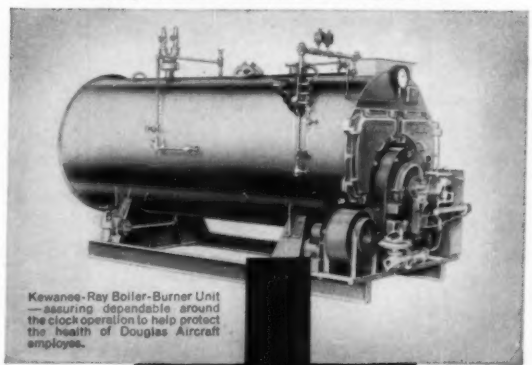

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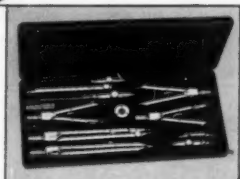

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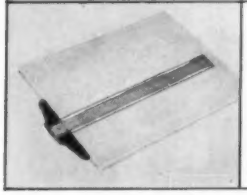

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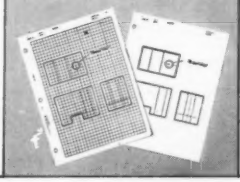

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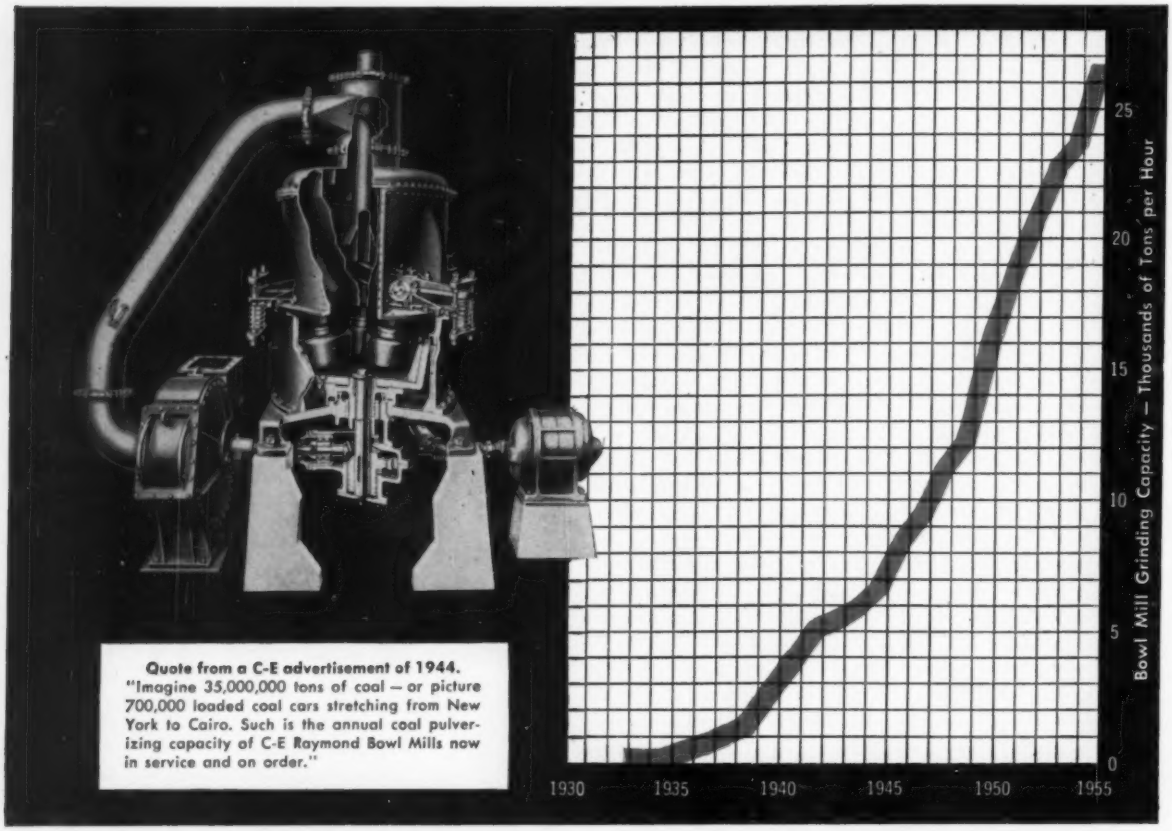
Quote from a C-E advertisement of 1944.
"Imagine 35,000,000 tons of coal — or picture 700,000 loaded coal cars stretching from New York to Cairo. Such is the annual coal pulverizing capacity of C-E Raymond Bowl Mills now in service and on order."
Bowl Mill Grinding Capacity — Thousands of Tons per Hour
0
5
10
15
20
25
1930
1935
1940
1945
1950
1955

When the paragraph quoted above was written in 1944, the C-E Raymond Bowl Mill had been on the market just 10 years. Obviously it had achieved tremendous acceptance in the power generation field. But see what has happened since. Those 700,000 cars have grown to 2,850,000* which, in a single train, would more than encircle the earth at the latitude of New York.

No one factor could possibly account for this widespread acceptance. Rather it is the fact that the Bowl Mill's record of performance in many hundreds of installations has been outstanding in all these important respects...

- **power consumption**
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- **control characteristics**
- **ability to maintain capacity with wet coal**
- **ability to maintain fineness through life of grinding elements**
- **quiet vibrationless operation**

The Bowl Mill's top performance on *all* these counts is the reason why utility engineers continue to accord it such widespread preference.

* Equivalent of 27,200 tons per hour shown on chart.

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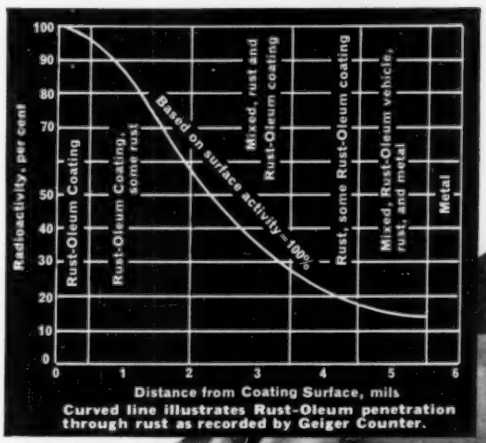
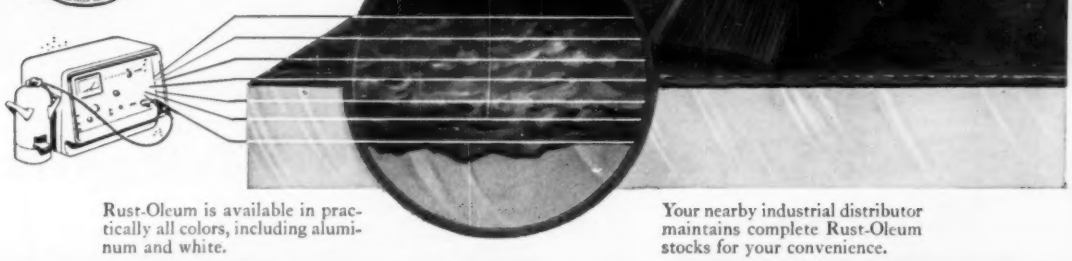
through rust to bare metal traced by Geiger Counter. To effectively stop rust—the vehicle of a protective coating, when applied over a sound, rusted surface—must penetrate through the rust down to bare metal. **Rust-Oleum does exactly that!—as proved by radioactive research!** Rust-Oleum's specially-processed fish oil vehicle was radio-activated and formulated into Rust-Oleum 769 Damp-Proof Red Primer—then applied to rusted test panels. Penetration *through rust* to bare metal by Rust-Oleum's specially-processed fish oil vehicle was then traced by Geiger Counter.

You stop rust, because Rust-Oleum's fish oil vehicle soaks deep down to bare metal and into the tiny pits where it drives out air and moisture that cause rust. You save, because this same *penetration* enables you to apply Rust-Oleum directly over rusted surfaces—usually eliminating costly surface preparations. Attach coupon to your letterhead for your thirty-page report entitled, "The Development of a Method To Determine The Degree of Penetration of a Rust-Oleum Fish-Oil-Based Coating Into Rust On Steel Specimens," prepared by Battelle Memorial Institute technologists.



Curved line illustrates Rust-Oleum penetration through rust as recorded by Geiger Counter.

There is only one Rust-Oleum. It is distinctive as your own fingerprint. Accept no substitute. Buy—and specify only Rust-Oleum. You'll be happy that you did.



Rust-Oleum is available in practically all colors, including aluminum and white.

Your nearby industrial distributor maintains complete Rust-Oleum stocks for your convenience.

RUST-OLEUM®

STOPS RUST!

See our Catalog in Sweets, or write for complete information.

ATTACH TO YOUR LETTERHEAD—MAIL TODAY

Rust-Oleum Corporation
2903 Oakton Street
Evanston, Illinois

- ☐ Complete literature including color charts.
- ☐ Thirty-page report on Rust-Oleum penetration.
- ☐ Nearest source of supply.

Now the finest of needle valves is available

416 Stainless throughout...

In the Marsh Needle Valve, operating men found a valve that was better all the way through. Then came the call for a valve of like quality and precision for corrosion service . . . to be 416 stainless steel throughout.

The valve illustrated here is the answer. Like the parent valve, this new valve has safety and strength to spare . . . guaranteed for working pressures up to 10,000 psi . . . equally efficient and effective in any lower pressure range.

It too is machined from solid bar stock—in this case, 416 stainless steel. Its precision-ground and-machined stem is hardened 416 stainless. Packing is the special "Marpak" ring . . . one-piece, non-binding, long-lasting. So finely built is this needle throttling and cut-off valve that it can be easily throttled down to exceptionally fine regulation even on extreme pressure.

Read the list of features opposite. Then write for new bulletin No. NV-2 containing complete details.

416 Stainless Steel ...all the way through!

- Body and stem guide machined from bar stock.
- Valve stem, hardened stainless.
- Packing, special Marsh "Marpak" moulded ring.
- Fine stem threads for strength and precision throttling.
- Deep inlet and outlet thread chambers.
- Bodies marked in accordance with MSS regulations.

Maximum Working Pressure 10,000 P.S.I.

Water, oil, gas or corrosive fluids not injurious to 416 stainless steel.

The new all stainless valves (Series 1924) includes globe and angle patterns with double female connections in sizes ⅛", ¼", ⅜", ½", ¾", 1"; also globe and angle valves with male inlet and female outlet in sizes ¼" and ½".

MARSH INSTRUMENT CO. Dept. 29, Skokie, Ill.
Sales affiliate of Jas. P. Marsh Corp.

Marsh Instrument & Valve Co. (Canada) Ltd.
8407 103rd Street, Edmonton, Alberta, Canada

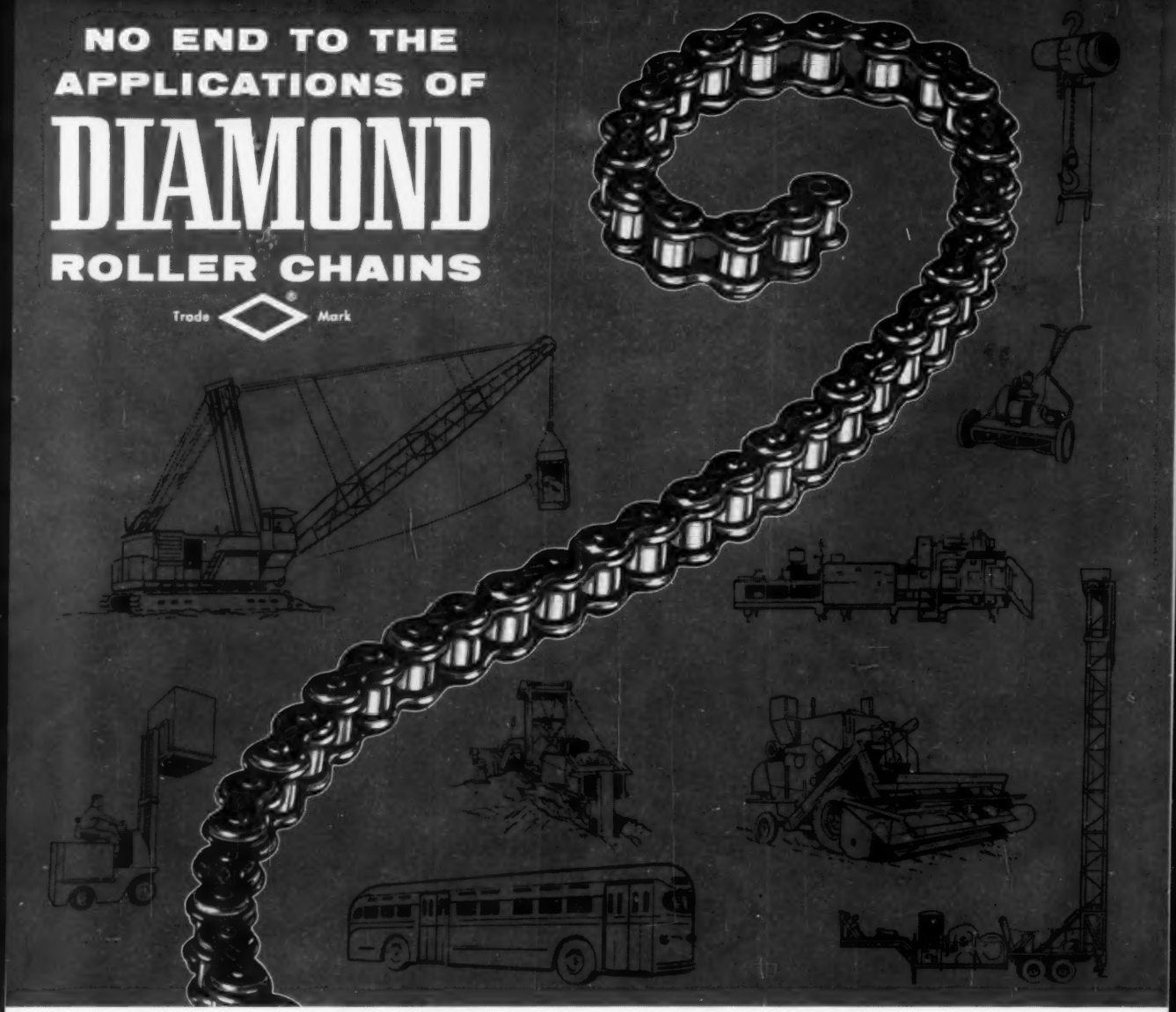
HOUSTON BRANCH PLANT: 1121 Rothwell Street, Sect. 15, Houston, Texas

MARSH

"THE STANDARD OF ACCURACY"

NO END TO THE APPLICATIONS OF DIAMOND ROLLER CHAINS

Trade ◇ Mark



WHEREVER POWER IS TRANSFERRED

Diamond Roller Chains are in successful application on equipment of every kind—wherever power is being transferred.

Wherever goods are moved, conveyed, lifted—wherever there is construction work, agricultural operation, mining—wherever power is transmitted or shafts driven in factory and mill—there you will find Diamond Dependable Power Transfer.

Wherever put to work, their universally acknowledged characteristics of high uniform quality, reserve strength and long-life low-cost performance provide for product and output improvement.

Over 65 years of experience devoted to this one product is at your disposal. For any application you have in mind, Diamond engineering staff can help you with sound recommendations.

DIAMOND CHAIN COMPANY, Inc.

Where High Quality is Traditional

Dept. 413 402 Kentucky Ave., Indianapolis 7, Indiana

Offices and Distributors in All Principal Cities

Please refer to the classified section of your local telephone directory under the heading CHAINS or CHAINS-ROLLER

Catalog 754 mailed on request. 64 pages of useful information.

DIAMOND ROLLER CHAINS

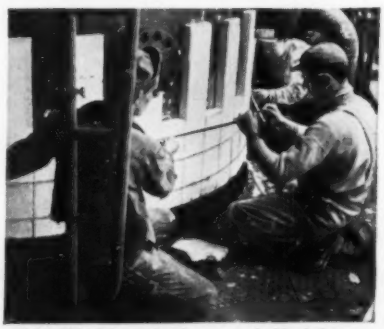
J-M 85% Magnesia is lightweight . . . easy for workmen to install half-sections on this 10″ steam line. Insulation work at the Grace Chemical plant was performed by Young Sales Corporation of St. Louis. Engineering and construction was directed by Foster Wheeler Corporation of New York.

Your Btu's and dollars go further when you specify **Johns-Manville 85% Magnesia**

. . . the choice of insulation engineers at Grace Chemical's new Memphis plant

INDUSTRY'S LONG-TIME standard for temperatures to 600F is still your best insulation buy. For J-M 85% Magnesia provides high insulating value, easy application, long life, initial low cost and minimum maintenance. That's why insulation engineers consistently specify J-M 85% Magnesia for modern installations like Grace Chemical's new anhydrous ammonia-urea plant. That's why it will pay you to specify J-M 85% Magnesia for your new plant or modernization program.

To assure you maximum value from your insulation dollar, Johns-Manville gives you complete drawing-board-to-job-site service. You get expert recommendations by the world's most experienced insulation engineers . . . plus expert installation by authorized J-M Insulation Contractors. Write today for further information on J-M 85% Magnesia and Johns-Manville's unmatched facilities to solve your insulation problems. Address Johns-Manville Box 60, New York 16, N.Y. In Canada, Port Credit, Ontario.



J-M 85% Magnesia also comes in block form. Here you see it being applied to a vertical drum at a New Jersey petroleum refinery.

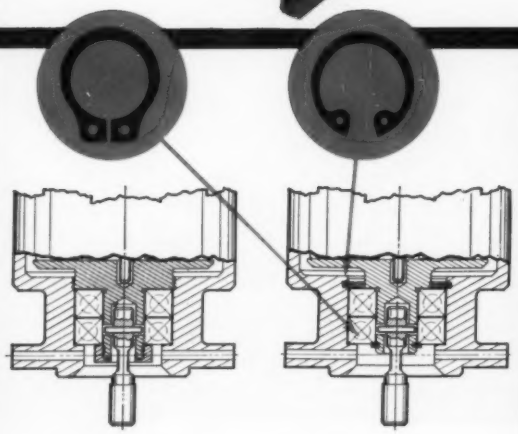
JM PRODUCTS

Johns-Manville *first-in* **INSULATION**

MATERIALS · ENGINEERING · APPLICATION

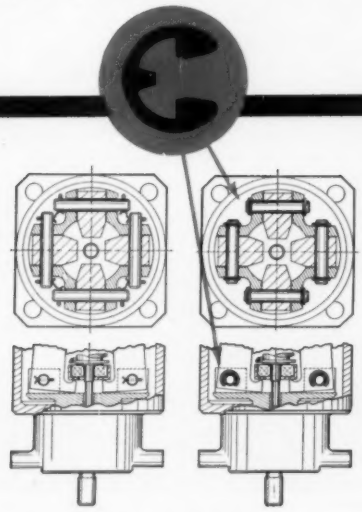
10 Waldes Truarc rings speed assembly— Eliminate parts and machining in precision control

Kahn Rotary Speed Control
Kahn and Company, Inc., of Hartford, Conn., use a total of 10 Waldes Truarc Retaining Rings in this new mechanical-electric translator for automatic control of rotary speed. Truarc rings act as positioners and retainers to eliminate parts, simplify operations, save labor, and speed assembly.



Rotor Installation. In the old way, ball bearing was retained by a threaded shoulder and threaded bearing cup retainer.

New way, using two Truarc Rings (Series 5100 and 5000) eliminates 4 threading operations, bearing shoulder and threaded bearing cup. Assembly is quicker and easier, two ounces lighter.



Flyweight Assembly. Formerly, 2 holes had to be drilled in each of the 4 pivots, and 8 cotter pins were required.

The new way, using 8 Truarc E-Rings (Series 5133), replaces holes with grooves, reduces pivot size, leaves no projecting parts. Rings snap into place, speed assembly time by three minutes per unit.

Whatever you make, there's a Waldes Truarc Retaining Ring designed to improve your product... to save you material, machining and labor costs. They're quick and easy to assemble and disassemble, and they do a better job of holding parts together. Truarc rings are precision engineered and precision made, quality controlled from raw material to finished ring.

36 functionally different types... as many as 97 different sizes within a type... 5 metal specifications and 14 different finishes. Truarc rings are available from 90 stocking points throughout the U. S. A. and Canada.

More than 30 engineering-minded factory representatives and 700 field men are available to you on call. Send us your blueprints today... let our Truarc engineers help you solve design, assembly and production problems... without obligation.

For precision internal grooving and undercutting ... Waldes Truarc Grooving Tool!

Send for new catalog supplement

WALDES TRUARC® RETAINING RINGS

Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y.
Please send the new supplement No. 1 which brings Truarc Catalog RR 9-52 up to date.
(Please print)

Name.....
Title.....
Company.....
Business Address.....
City.....*Zone*.....*State*.....

ME 068

WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787. and other U. S. Patents pending. Equal patent protection established in foreign countries.

EDWIN J. THOMAS

Portrait by Fabian Bachrach

"...added over 20,000 employees to The Payroll Savings Plan."

"The Savings Bond Program—like any other program in a corporation—will succeed *only* if it has the complete support of top management. Recently the Goodyear Tire & Rubber Company added over 20,000 employees to the Payroll Savings Plan, attaining an overall participation of over 71%. While the drive itself was successful I feel the job is only half done. Now we are installing a program to maintain this high peak of participation. Such a program will constantly keep the merits of the program before each employee, encouraging him to provide his own security through this effortless plan of saving."

EDWIN J. THOMAS, ***President***
The Goodyear Tire & Rubber Company, Inc.

What is the percentage of employee participation in *your* Payroll Savings Plan? If it is less than 50%, get in touch with Savings Bond Division, U.S. Treasury Department, Washington, D. C. Your State Sales Director will be glad to help you increase your participation to 60% or higher. A phone call, telegram or letter to Savings Bond Division, U.S. Treasury Department will bring a prompt response.

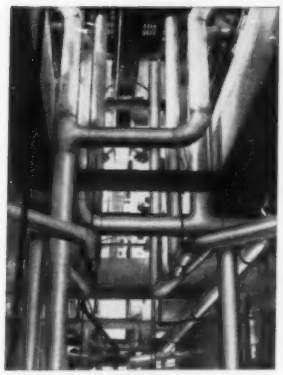
The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and

MECHANICAL ENGINEERING

Solve liquid and gas handling problems with tubular products of ALCOA ALUMINUM

Having trouble with your present pipe or tube? These light, strong, corrosion-resistant tubular products of ALCOA® Aluminum may be the solution to your problems. Each day, new users find them best for the safe, economical handling of "problem" liquids and gases.

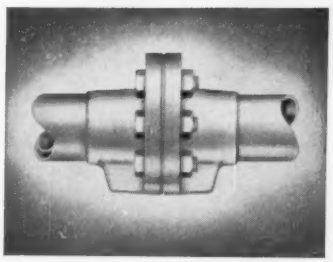
ALCOA ALUMINUM PIPE



This high-quality seamless pipe is the least expensive (per foot) metal pipe for a variety of applications demanding outstanding corrosion resistance or product protection. The smooth surface of aluminum pipe reduces fluid flow resistance. Its thermal conductivity is high; it is nonsparking and can be welded, threaded or mechanically coupled as necessary.

Seamless ALCOA Aluminum Pipe is available in standard diameters up to twelve inches and in a variety of alloys suited to particular requirements of weight and mechanical strength.

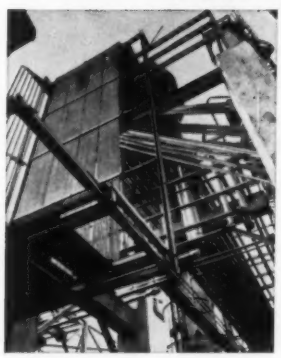
UNITRACE® Steam-traced Pipe



Unitrace eliminates the cost of external steam jackets or steam tracer tubes because the steam line is an integral part of the aluminum pipe. It can cut your labor-installation costs by as much as 30%, and it will reduce (or even eliminate) the cost of thermal insulation for the lines.

The outstanding corrosion resistance natural to aluminum makes Unitrace ideally suited to the handling of naval stores, molten sulfur, ammonium nitrate solutions and other fluids normally requiring steam tracing. It lends itself to easy shop fabrication of standard lengths and can be formed with ordinary pipe-bending tools. A two-inch pipe size is standard and larger sizes are subject to special inquiry.

ALCOA® UTILITUBE



When the design calls for coiled tube, ALCOA Utilitube is best. It's economical to use . . . costing up to 40% less than copper tube. It is light, easy to handle and available in long lengths—up to 1,000 feet or more. Corrosion resistance is excellent.

ALCOA Utilitube has high fatigue and bursting strengths, it has good flaring and forming characteristics and work-hardens less under repeated bending. ALCOA Utilitube is used for instrument air lines, steam tracer lines, hydraulic and lubricating lines and refrigeration tubing.

ALCOA ALUMINUM HEAT EXCHANGER TUBES

Aluminum's natural resistance to oxidation and to corrosion by water, hydrogen sulfide, ammonia, carbon dioxide and many other compounds makes it an ideal material for heat exchanger tubes. Other important advantages are its high heat conductivity, light weight, ease of fabrication and *low cost:* 1/3 less than mild steel, 1/2 as much as Admiralty brass, 1/5 as much as Stainless.

IMMEDIATE DELIVERY—Each of these outstanding tubular products of ALCOA Aluminum is available for immediate delivery through more than 70 ALCOA distributor and jobber warehouses conveniently located throughout the country. Call on them for technical assistance in solving your pipe or tube problems. Rely on them to cut your investment in stocks and lower your handling costs . . . with deliveries geared to your requirements . . . from complete warehouse stocks of materials which will be cut to the exact sizes you specify.

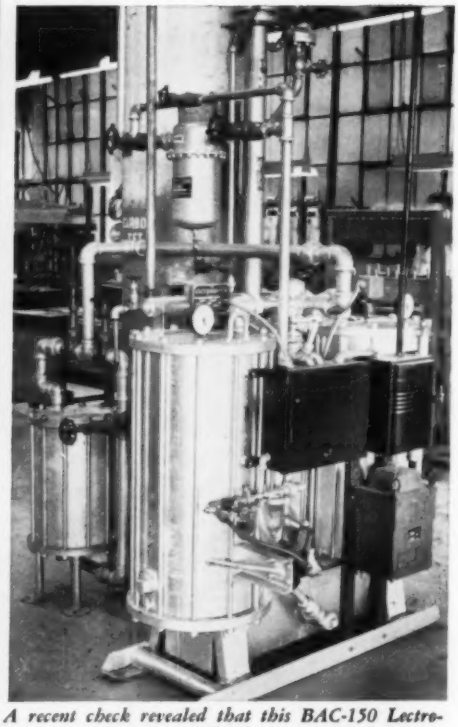
For the name of your nearest ALCOA distributor or jobber, see the Yellow Pages of your telephone directory—or write ALUMINUM COMPANY OF AMERICA, 908-F Alcoa Building, Pittsburgh 19, Pennsylvania.

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

Thousands of dollars per month saved when DRYair replaced premium-grade nitrogen in testing electronic equipment

A cloud of fog forms as moist air from the room meets the –67° air in the test chamber.



A recent check revealed that this BAC-150 Lectrodryer is delivering air dried to a –70°F. dewpoint.*

ELECTRONICALLY-CONTROLLED pneumatic actuators built by the Electronics Division of Thompson Products, Inc. of Cleveland maintain 400 cycles per second within limits of plus or minus one per cent—classed as "phenomenal accuracy" by men who know. Regulation and testing of this equipment is carried on in cold chambers simulating environmental conditions of altitude and temperature.

Standard bottled nitrogen was used at first to drive these mechanisms, but it quickly froze up as it has a dewpoint of –50°F. Then they went to premium-grade nitrogen having a dewpoint of –70°, but this costs 70 cents per cubic foot and as many as seven bottles of nitrogen were used per unit.

Now they have this Lectrodryer. It takes air from the shop line, cleans and dries it to –70°F. dewpoint, actually saving them thousands of dollars every month. Thus the Lectrodryer pays for itself many times over.

Have you a moisture problem? Write, giving data on it, to Pittsburgh Lectrodryer Company, 335 32nd Street, Pittsburgh 30, Pennsylvania (a McGraw Electric Company Division).

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

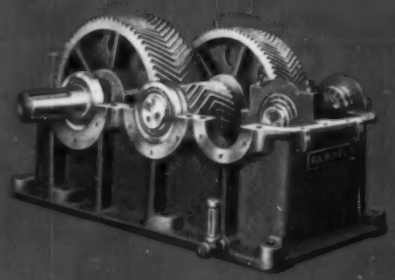
LECTRODRYER

* REGISTERED TRADEMARK U.S. PAT. OFF.

MEET YOUR NEEDS

from Farrel's new, broader line of speed reducers

DR-96, largest in the standard line of double reduction units. Has pump and cooler for increased thermal rating.



Standard double reduction unit. Both sets of gears are continuous-tooth type.

Single reduction unit with cover removed.

new sizes available in heavy-duty and light-type units

Farrel® speed reducers have long been preferred for their ability to meet unusual and exacting requirements. Now, the complete line has been re-engineered, rerated and expanded to extend the recognized advantages of the units to additional applications and fields.

Both heavy-duty and light-type units are available in a broader range of sizes, and in a series of standard ratios as follows: *Single reduction* — from 1½:1 to 10:1; *double reduction* —from 10:1 to 70:1; *triple reduction*— from 83.9:1 to 323:1. Special designs are also available, including speed-change units having two or more selective speeds and drives to meet special requirements.

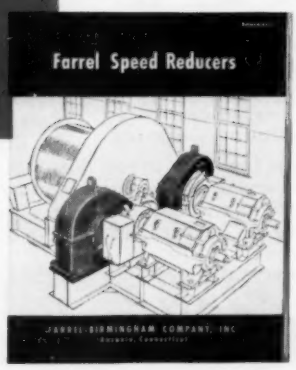
Farrel speed reducers incorporate a number of important improvements. These result from a continuing research program, and from experience gained in the application of gear units to the many types of machines manufactured by the company.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT

Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.

Sales Offices: Ansonia, Buffalo, New York, Boston, Akron, Detroit, Chicago, Minneapolis, Fayetteville (N. C.), Los Angeles, Salt Lake City, Tulsa, Houston

Farrel-Birmingham®



THIS FREE BOOKLET gives complete details of the full line of Farrel speed reducers. It includes specifications, horsepower rating tables, overhung load capacities, dimensions and weights. Send for your copy today.

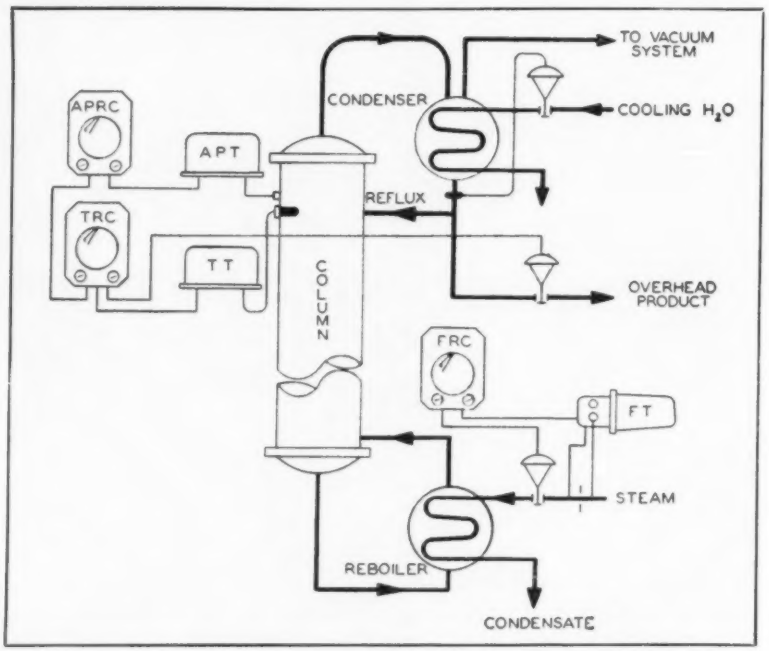
FB-1080

DISTILLATION COLUMN CONTROL

One of a series of basic instrumentation recommendations for the unit operations

GEORGE E. HOWARD, Manager
Application Engineering Dept.

"Unquestionably, our reputation for successful distillation column control is based on broad experience with every type of distillation problem, and a complete line of instruments that meets every need."



PROBLEM

To obtain required separation of components in a batch distillation column in the shortest practical time at the lowest possible cost. This is complicated by the fact that composition of the charge varies continuously, which means that the reflux ratio must be continually adjusted.

SOLUTION

Maintain constant heat input to column reboiler and automatically vary reflux ratio to hold specified overhead composition.

INSTRUMENTATION

Steam flow controller maintains heat input at the value required for optimum vapor velocity as determined by column design. Flow transmitter is located directly at point of measurement for ease of installation and maintenance. Receiver controller gives continuous chart record for evaluating operation and for accounting purposes.

Column Temperature Controller regulates reflux to accurately maintain equilibrium temperature in the column. Since equilibrium temperature is a measure of composition, this is an effective means of holding overhead product at required purity. Precision control depends upon instantaneous detection of column temperature changes hence SPEED-ACT* response in the transmitter is used to overcome inherent measurement lag. Similarly, PRE-ACT* response in the controller gives fast corrective action to overcome inherent lags in processing equipment.

Column Pressure Controller senses absolute pressure changes in the column and automatically adjusts the column temperature controller to compensate for the effect of pressure changes on the equilibrium temperature. A narrow range, barometrically compensated pressure transmitter locally mounted detects the slightest change in column absolute pressure. Chart records on temperature and pressure controllers provide a constant check on column operation and product quality.

Overhead Product Temperature Controller regulates the flow of cooling water to insure complete condensation of overhead vapors. This controller also prevents excessive subcooling of reflux that would result in unnecessary heat load on the column reboiler.

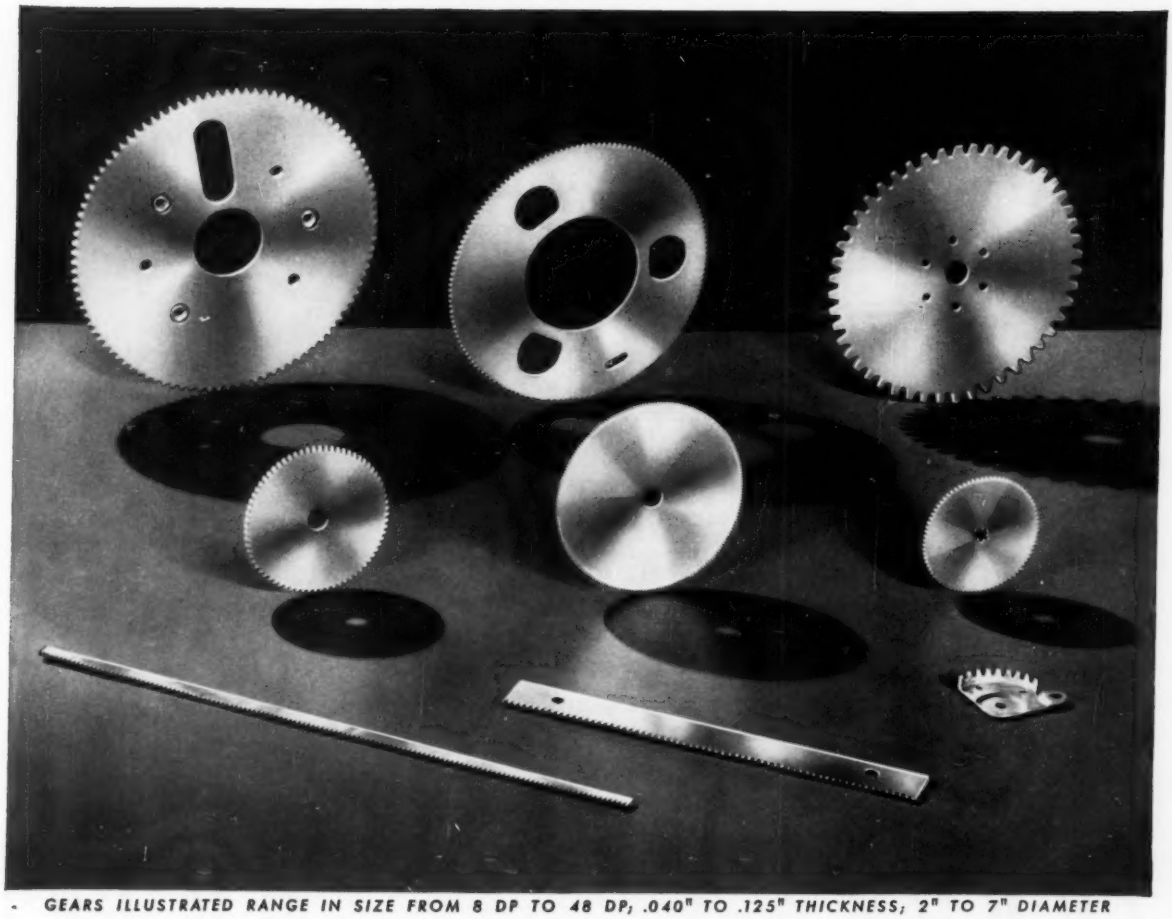
BENEFITS

1. Constant product quality.
2. Minimum operating cost.
3. Continuous record of process operation.
4. Elimination of tedious manual adjustment.
5. Precision control despite process-load changes.

Send for Data Sheet No. 11 for other control recommendations for batch and continuous distillation; or call in your Taylor Field Engineer. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

*Trade Mark

Taylor Instruments **MEAN ACCURACY FIRST**



GEARS ILLUSTRATED RANGE IN SIZE FROM 8 DP TO 48 DP; .040" TO .125" THICKNESS; 2" TO 7" DIAMETER

HOW TO CUT ASSEMBLY TIME AND GEAR COSTS!

Assembly lines *flow faster* with Winzeler Stamped Gears. Down-time headaches disappear. Finished assemblies run S-M-O-O-T-H . . quiet. And they last longer, too.

Gaining greater accuracy and all-round quality in *Stamped* Gears has been a specialty of ours for years. Improved modern methods of Tooling, Stamping, and Assembling have resulted in a new high degree of precision that remains *uniform* in high speed, mass-production runs. Regardless of the quantity of Gears you need, you can depend upon WINZELER Stamped Gears to *consistently* measure up to the most exacting specifications. Your own assembly operations will soon reflect the savings made possible by these better, more uniform Stamped Gears.

WINZELER research has cut Gear costs, too. Now, for many applications, single stampings can be laminated and indexed to produce wider faces at savings up to 60%!

We stamp Gears in production runs, in sizes from 96 to 8 dp, and from .006 to 3/16" thickness . . and up to 7" diameter. Tell us about your needs. Send drawings or descriptions today. Ideas and low cost estimates incur no obligation.

WINZELER Stamped Gears

MAIL THE COUPON FOR FREE STAMPED GEAR FOLDER

WINZELER MANUFACTURING & TOOL CO.,
1712 WEST ARCADE PLACE, CHICAGO 12, ILLINOIS

Gentlemen:

Please mail to me, at once, a copy of the free WINZELER Stamped Gear folder.

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

OUTSTANDING WOLVERINE DEVELOPMENTS

IN COPPER

IN ALUMINUM

INCREASED HEAT TRANSFER

Wolverine Trufin**—with integral fins—has much greater heat transfer surface than plain tube—transfers more BTU's per foot of tube. Trufin is available in a wide range of sizes and alloys in both copper and aluminum.

INCREASED SAVINGS THROUGH SPINNING

One-piece, tubular-shaped parts, with fully or partially closed end treatments, are produced in a single speedy operation by spinning. Wolverine spinning produces dry, clean parts in either copper (Wolverine Copper Spun End Process*) or aluminum (Wolverine Aluminum Spun End Process †).

PRECISION IN FABRICATING TUBULAR PARTS

Wolverine's rigid quality control, its complete fabrication facilities, and the Tubemanship of its skilled employees insure fabricated tubular parts that will meet the toughest specifications. Wolverine is equipped to fin, spin, bend, coil, flare, expand, bead—*you name it*—in either copper or aluminum.

COMPLETE ALLOY AND SIZE RANGE

Wolverine manufactures tubing in a wide range of alloys and sizes in both copper and aluminum. You receive the tube or tubular-shaped part that is exactly right for your job—every time!

JOINING DISSIMILAR METALS

Sometimes, manufacturers wish to use both aluminum and copper tube in the same system. Wolverine furnishes handy copper-to-aluminum connectors in both ⅜" and ⅝" tube diameters.

Wolverine Tube, 1483 Central Ave., Detroit 9, Mich.

Wolverine Trufin is available in Canada through the Unifin Tube Company, London, Ontario.

* *REG. U.S. PAT. OFF.

** A PATENTED PROCESS RE. 22465

† PROCESS PATENT APPLIED FOR

Creative Tubemanship—IN ACTION!

DIVISIONS OF CALUMET & HECLA, INC.

CALUMET DIVISION
WOLVERINE TUBE DIVISION
CANADA VULCANIZER & EQUIPMENT CO., LTD.
FOREST INDUSTRIES DIVISION
GOODMAN LUMBER CO.

WOLVERINE TUBE

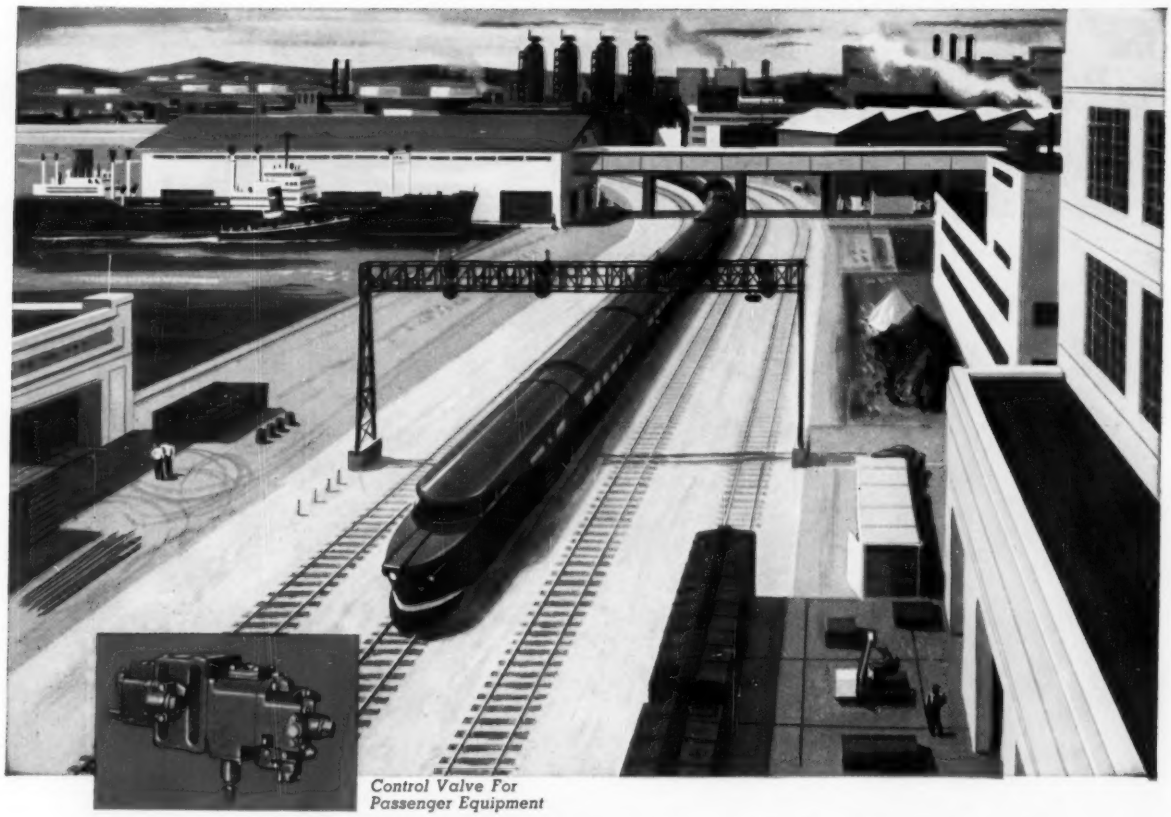
Division of Calumet & Hecla, Inc.

Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.

EXPORT DEPT., 13 E. 40TH ST., NEW YORK 16, N.Y.

5286



Control Valve For Passenger Equipment

Transportation Means Trains, Ships, Trucks, Planes and— ENGINEERING

The ever-increasing demand for greater tonnage, higher speeds, finer appointments and assured safety for moving people and products brings into high focus the things that make such progress possible.

The modern freight train and tomorrow's sleek streamliners are advances in which the engineering of The New York Air Brake Company plays an important role. Precision engineering, plus craftsmanship, plus pneumatics "know-how" makes fingertip control for positive, velvet-smooth braking a reality on America's railroads.

For today's jet air liners The New York Air Brake Company builds STRATOPOWER Hydraulic Pumps. These Pumps have the watch-like precision to provide dependable Fluid Power for operating control surfaces and performing many other important functions on civilian and military aircraft, rockets and guided missiles.

Passenger ships, freighters and tankers, although larger and speedier than ships of yesteryear, load and discharge cargoes quicker and maneuver more alertly. DUDCO and HYDRECO Fluid Power equipment brings simplicity, ease, speed and safety to steering, raising and lowering hatches, powering winches and cargo booms and other shipboard functions. Ashore, these same components operate lift trucks and conveyors. You'll also find AURORA and KINNEY Liquid Handling Pumps . . . AURORA Pumps for fire fighting, boiler feed and water systems . . . KINNEY Pumps for transfer of bunker fuel, asphalt, molasses, crude oil and gasoline.

KINNEY High Vacuum Pumps contribute much to modern transportation. High Vacuum technology is the magic ingredient in the manufacture of Radar, Electronic and Electrical devices, Refrigeration, Air Conditioning and the practical application of Atomic power.

Look to The New York Air Brake Company for progress and the engineering that serves both you and your products.

Write for full information on new developments in Hydraulic, Liquid Handling and Vacuum equipment.

KALAMAZOO DIVISION
Kalamazoo, Mich.
HYDRECO Gear-Type Hydraulic Pumps, 3 to 120 gpm; Fluid Motors, 3 to 52 hp; Cylinders; Control and Auxiliary Valves; 1500 psi. DUDCO Dual-Vane Hydraulic Pumps, 3 to 120 gpm; Fluid Motors, 7 to 140 hp; 2000 psi operation.

WATERTOWN DIVISION
Watertown, N. Y.
Railroad air brake equipment of all types, STRATOPOWER Hydraulic Pumps for Aircraft, to 3000 psi.

AURORA PUMP DIVISION
Aurora, Ill.
Liquid Handling Pumps, Centrifugals and deep well Turbines, 7000 gpm, 500 ft. heads. Turbine-type, 150 gpm, 600 ft. heads. Condensate Return Units.

KINNEY MANUFACTURING DIVISION
Boston, Mass.
Rotating Plunger and Heliquad Liquid Handling Pumps, to 3000 gpm. Vacuum Pumps, 0.2 micron, evacuate 1800 cfm.

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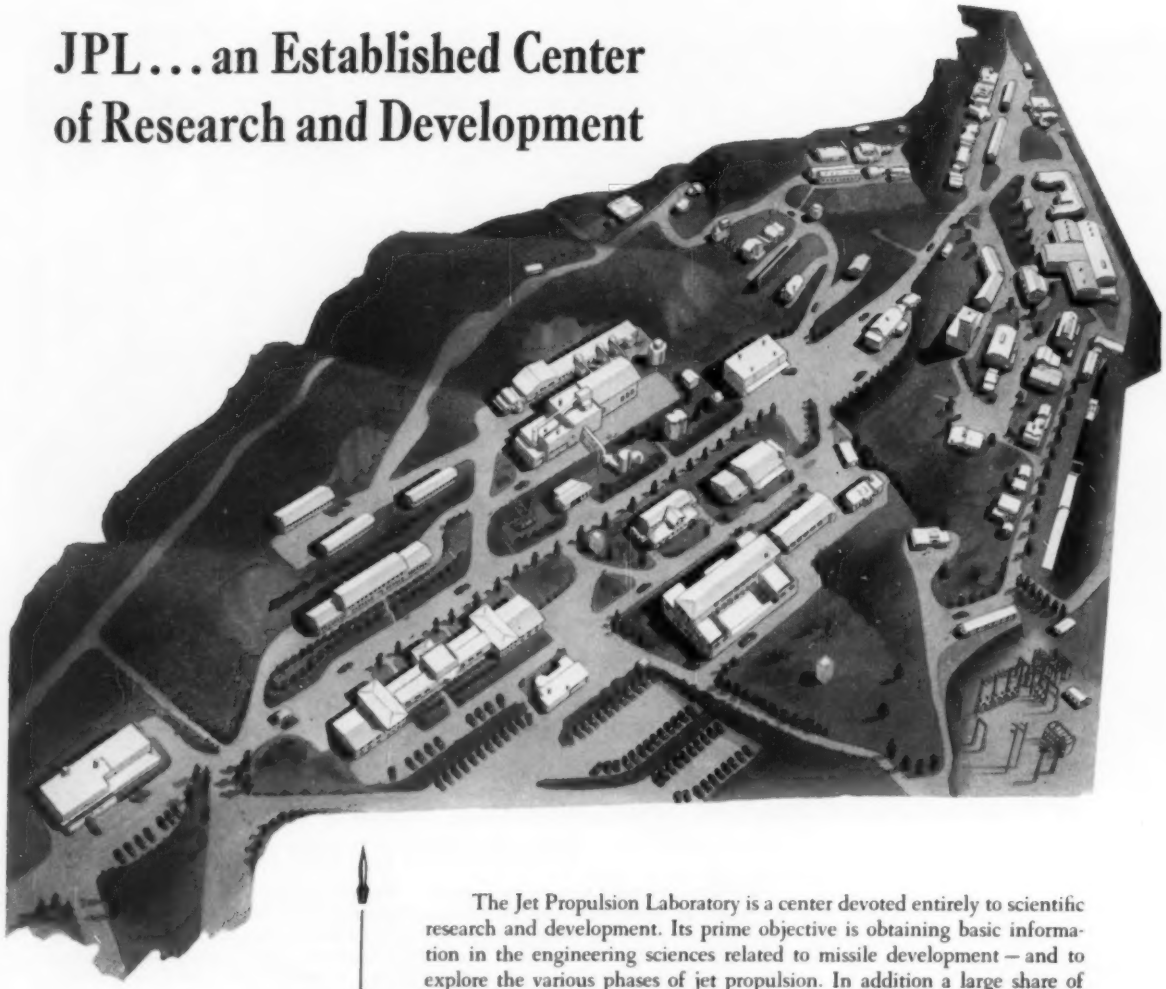
INTERNATIONAL SALES OFFICE, 90 WEST ST., NEW YORK 6, N. Y.

JPL . . . an Established Center of Research and Development



The Jet Propulsion Laboratory is a center devoted entirely to scientific research and development. Its prime objective is obtaining basic information in the engineering sciences related to missile development – and to explore the various phases of jet propulsion. In addition a large share of its program is devoted to fundamental research in practically all of the physical sciences.

The Laboratory extends over more than 80 acres in the foothills of the San Gabriel mountains north of Pasadena. It is staffed entirely by personnel employed by the California Institute of Technology and conducts its many projects under contracts with the U.S. Government.

Exceptional opportunity for original research coupled with ideal facilities and working conditions have naturally drawn scientists and engineers of a very high caliber. These men, working in harmony, are building a very effective task force for scientific attack on the problems of the future.

An unusual atmosphere of friendliness and cooperation is apparent at the "Lab" and newcomers soon sense the warmth of their acceptance. New advanced projects are now providing some challenging problems – and good jobs for new people.

If you would like to develop your skill and knowledge at the "Lab" and, at the same time, help us solve some of our problems – write us today.

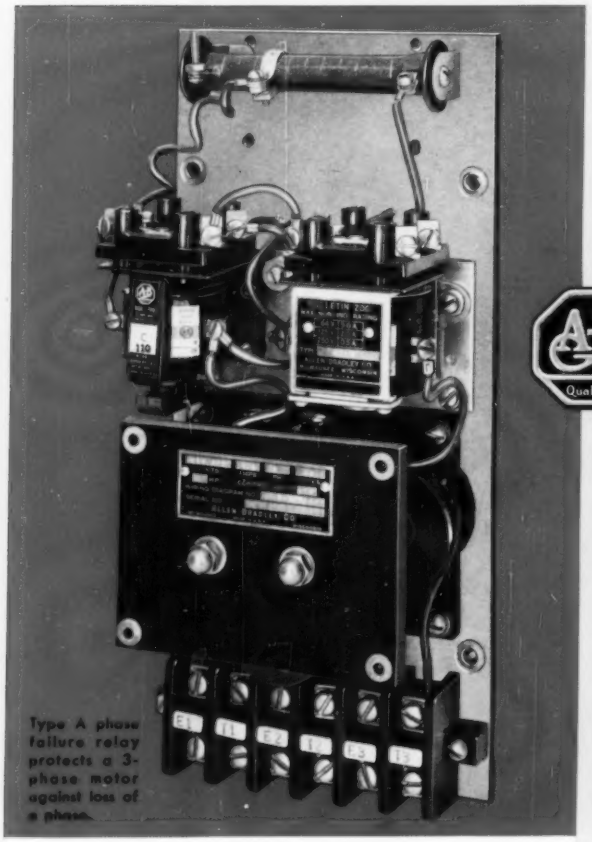
★ At this time we are particularly interested in interviewing graduate engineers and scientists in the fields of aerodynamics, aircraft structures, mechanical engineering, chemistry, chemical engineering, heat transfer, electronics, systems analysis, electromechanical instrument design, instrumentation, metallurgy, nuclear physics and solid state physics.

These men should be definitely interested in scientific research and development relating to the problems of the future.

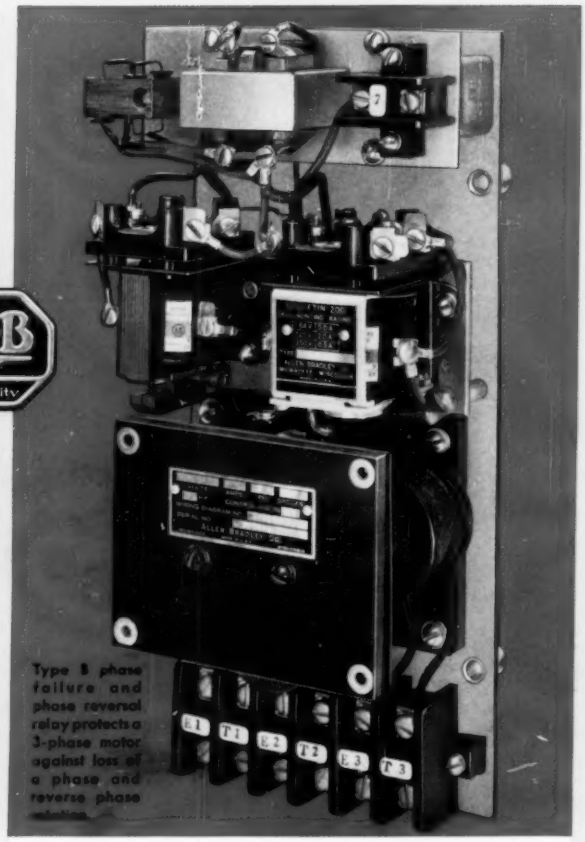
CALTECH jpl **JET PROPULSION LABORATORY**

A DIVISION OF CALIFORNIA INSTITUTE OF TECHNOLOGY

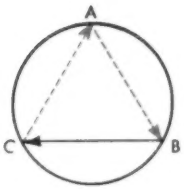
PASADENA, CALIFORNIA



Type A phase failure relay protects a 3-phase motor against loss of a phase.

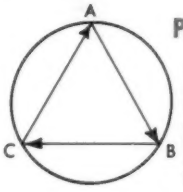


Type B phase failure and phase reversal relay protects a 3-phase motor against loss of a phase and reverse phase



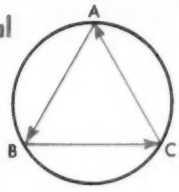
Phase Failure

This relay is sensitive to current in all lines to the 3-phase motor. If one current fails or becomes much less than current in other 2 lines, relay opens control circuit. Protects motor against failure of a phase on primary side of distribution transformer supplying motor, even tho it has wye-delta windings.



Phase Reversal

In addition to phase failure, this relay detects phase sequence and opens motor control circuit when a phase has been reversed.



RELIABLE PHASE FAILURE OR PHASE REVERSAL PROTECTION

The Bulletin 812 Type A phase failure relay is a static device which compares the currents in each of the three lines supplying a motor from a 3-phase system. In case the current in one line fails or becomes much less than that in the other two lines, the relay operates to open the control circuit to the starter which disconnects the motor from the line and prevents it from running single phase.

Both the Bulletin 812 Type A and Type B relays operate over a wide range of current, and thus coils do not have to be accurately selected for the precise current being drawn by the motor. These relays will function accurately for currents from no load to locked rotor.

The control circuit contacts are opened in three or four cycles after a phase failure occurs, and thus the relay can be used to protect against the failure of a motor to reverse. In the event of a single phase or of a phase failure, the Bulletin 812 relays will operate dependably because the construction does not include frail or moving parts, especially in the sensitive portion of the system. There are no delicate parts to get out of adjustment, or bearings which might stick and cause faulty operation.

The Bulletin 812 relays are built in only four sizes and will reliably protect motors with full load currents from 1.25 amperes to 300 amperes against phase failure and phase reversal. Let us send you more detailed information about this up-to-date answer to phase failure and phase reversal problems!

Allen-Bradley Co.
1316 S. Second St.
Milwaukee 4, Wis.

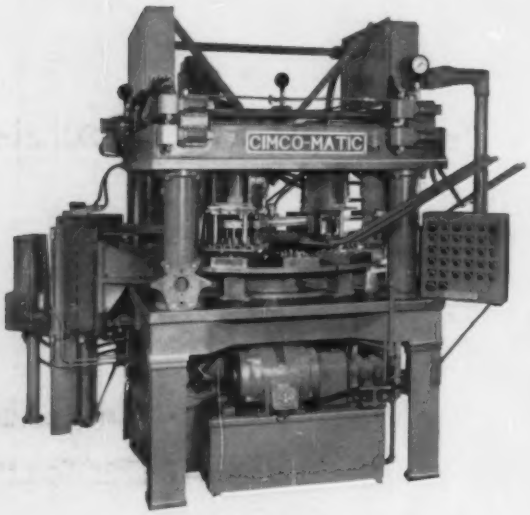
ALLEN-BRADLEY
QUALITY
PHASE FAILURE & REVERSAL RELAYS

In Canada — Allen-Bradley Canada Ltd.
Galt, Ont.

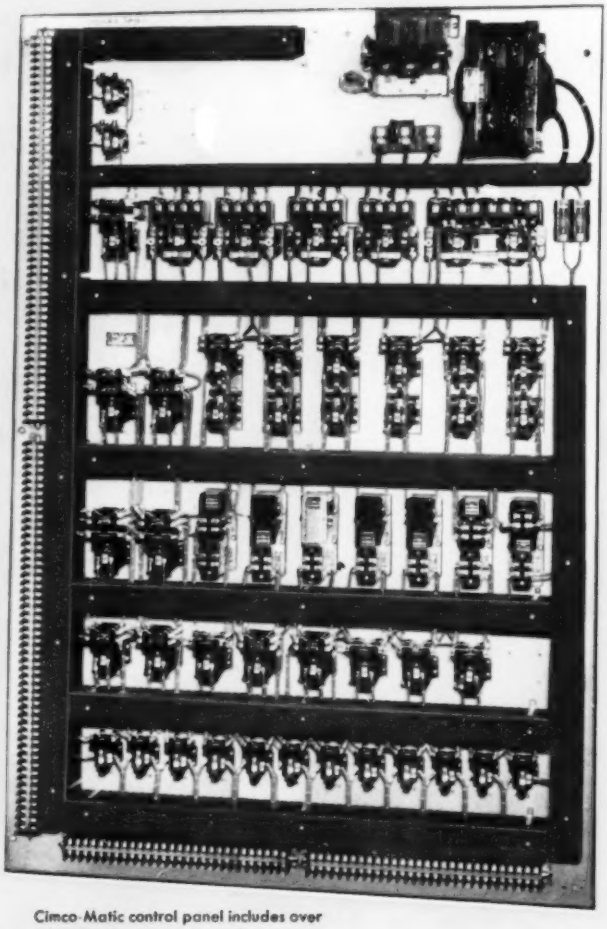
6-56-MR

Automatic machinery speeds up production . . . but to obtain the full benefit, the electrical control components must be trouble free. Therefore, leading machinery builders favor Allen-Bradley controls. They have found that A-B controls satisfy all operating requirements. The simple one-moving-part design is your guarantee of trouble free performance. You help yourself when you specify "Allen-Bradley."

Send for the A-B Handy Catalog.

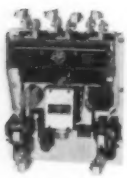


Cimco-Matic machine for automatically assembling Chrysler inner brake plates.



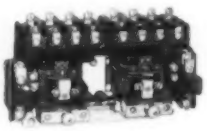
Cimco-Matic control panel includes over 40 A-B starters, relays, timers, etc.

Some Allen-Bradley control items—universally recognized for trouble free operation



Bul. 709 Size 7 solenoid starter for 300 hp, 220 v, 600 hp, 440-550 v motors.

Bul. 709 Size 1 solenoid starter for 5 hp, 220 v, 7½ hp, 440-550 v motors.



Bul. 705 Size 1 reversing switch with switches electrically and mechanically interlocked. Available in 9 sizes for motors up to 300 hp, 220 v, 600 hp, 440-550 v.

Bul. 704 Size 1 hum-free contactor with magnetic latch.

Bul. 702 Size 2, 50 ampere solenoid contactor.

Bul. 700 Type C solenoid relay, rated 10 amp. 600 v, max.

Bul. 700 BX, 4 pole universal relay with N.O. & N.C. contacts.

Bul. 800T oiltight operating units for machine tool service. They are available in many handy forms.

Bul. 800T 5 button pendent station.

Bul. 800T oiltight control station for machine tool service.

Bul. 894 disconnect with visible contacts for combination starters and control panels.

Bul. 806 rotary pilot switch, 15 & 25 amp. 600 v.

Bul. 802T adjustable lever oiltight limit switch.

Bul. 849 timers available in wide variety of types. Adjustable from 1/6 sec. to 3 min.

Allen-Bradley Co.
1316 S. Second St.
Milwaukee 4, Wis.

ALLEN-BRADLEY

RELAYS & CONTACTORS

In Canada—Allen-Bradley Canada Ltd.
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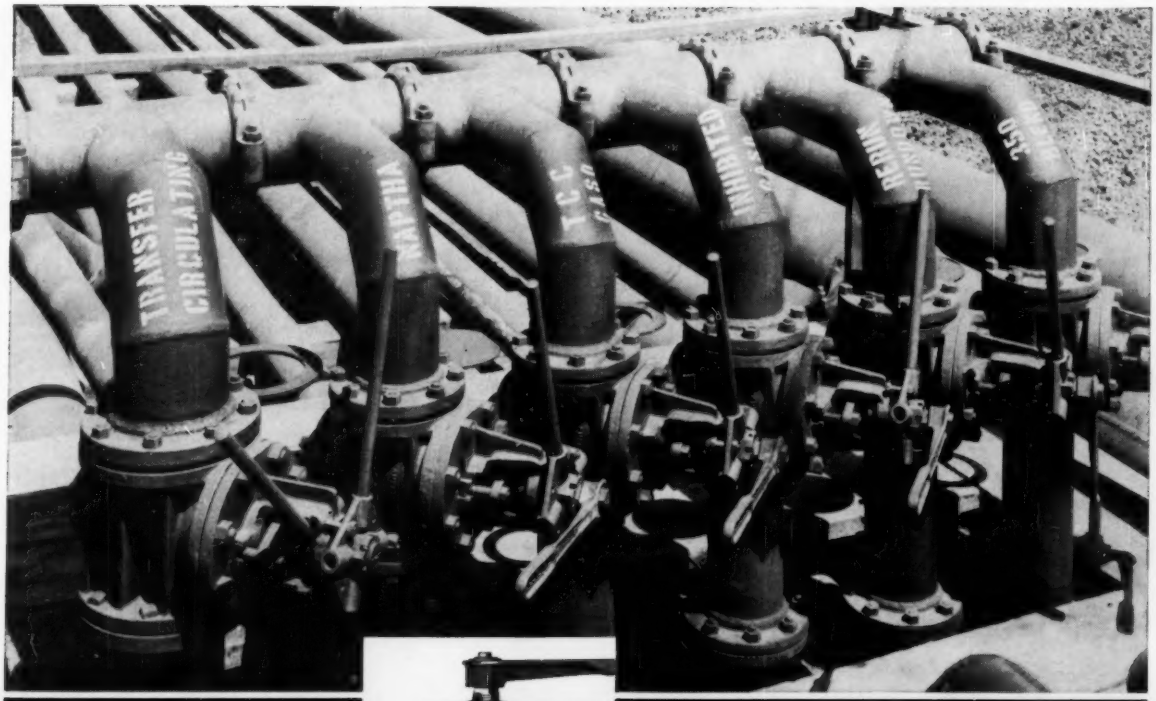
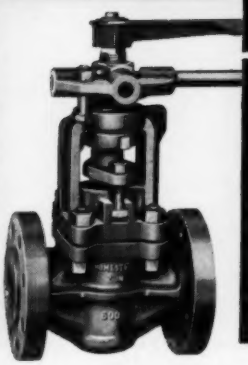
6-56-MR



if your problem is...

- TEMPERATURE
- PRESSURE
- CORROSION...



HOMESTEAD *Lever-Seald* **PLUG VALVES** *will solve it...*

Conditions which cause ordinary valves to fail --corrosive, erosive, viscous, or volatile hard-to-hold fluids, plus temperature or pressure extremes --are everyday jobs for Homestead Lever-Seald Valves. Why? Because they *are built to operate under all conditions!* They never stick!

Every Homestead Lever-Seald Plug Valve has a powerful lever and screw device that does double duty. It presses the tapered plug firmly into its seat to form a drop-tight seal, and also provides a positive means to relieve seating pressure and permit easy operation.

Lever-Seald Homestead Valves give extra long, leak-proof service, too, because all operating parts and seating surfaces are protected from line fluids in both the open and closed positions. You can prove their economy to your own satisfaction, by making your next replacement a Homestead Lever-Seald.

Your choice can be made from valves cast of metals and alloys to specification in sizes from 1" to 12"; for pressures from vacuum to 1500 pounds; temperatures from 40° below zero to 1100°F. Dry seat or pressure gun lubricated optional.

You'll find our VALVE REFERENCE BOOK No. 39-3 interesting and helpful. It's yours for the asking.

MAIL THE COUPON TODAY!

Without obligation, send me Valve Reference Book No. 39-3 describing Homestead Lever-Seald Plug Valves.

Name_____ Title_____

Company_____

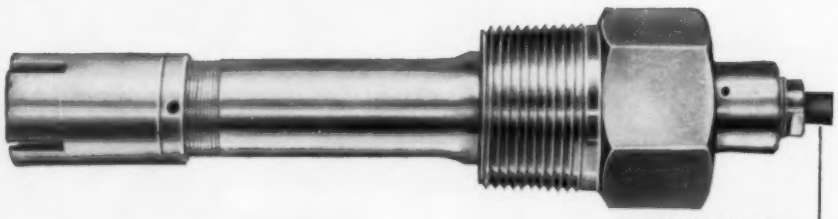
Address_____

City_____ State_____

HOMESTEAD VALVE MANUFACTURING COMPANY

P. O. BOX 38 *"Serving Since 1892"* CORAOPOLIS, PA.

NEW! TODAY'S MOST ADVANCED CONDUCTIVITY CELL



Furnished with valve for removing under pressure.

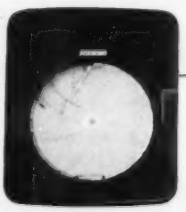
Exclusive New Carbon Electrode Design
No Platinizing Required
Practically Maintenance-Free
Leakproof—Even at 125 psig

Here's the biggest advance in conductivity cell design in years! Foxboro Carbon Electrode Conductivity Cells now virtually eliminate cell and electrode maintenance in conductivity measurements up to 10,000 micromhos!**

Foxboro Carbon Electrodes provide all the desirable surface characteristics of platinized metallic electrodes, yet require no platinization or other special coating. Cleaning, if necessary, involves simply a light brushing to keep them operating at peak efficiency. They're cased in stainless steel or brass (not glass) — you don't have to "handle with care". The electrodes are solidly anchored . . . cell constant can't change during cleaning or operation. What's more, you're sure of leak proof operation. Special "O"-ring seals and the foolproof Foxboro cable-seal protect the cell at pressures up to 125 psig — even when completely immersed.

These rugged cells, with Foxboro Dynalog* measuring instruments, form completely integrated systems for measurement or control . . . ideal for any industrial applications. For full details, write for Bulletin 19-13. **The Foxboro Company 966 Neponset Ave., Foxboro, Mass., U.S.A.**

**Available with constants of .01, 0.1, and 1.0. For measurements above 10,000 micromhos, specify Foxboro Platinum Electrode Conductivity Cells.



DYNALOG*

Direct-Reading Conductivity Measuring Instruments

Provide unequalled accuracy, sensitivity, and speed of response for conductivity measurements and control. Dynalog's step-less capacity balancing system eliminates slidewire maintenance. No standardizing necessary. 1000-cycle A.C. voltage to the conductivity cell keeps polarization effects at a minimum. Multi-Record Dynalog Instruments available for recording up to 6 different conductivity values on a single chart.

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FOXBORO
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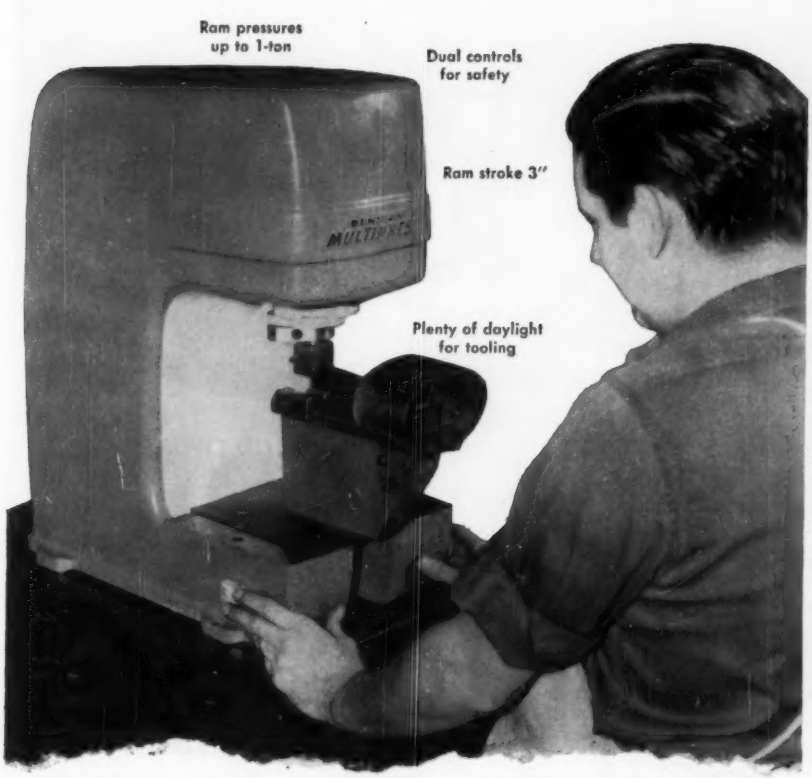
CARBON ELECTRODE CONDUCTIVITY CELLS

HOW TO SIMPLIFY PRESSING OPERATIONS

...assembling – riveting – marking – trimming – broaching – punching



PREVENTS BREAKAGE of plastic units in riveting of metal inserts.

ELIMINATES SCRAP in assembly of bearings at rates of 200 to 300 per hour.

SPEEDS ASSEMBLY of brass cone to steel stem... 800 to 900 per hour.

easily tooled for any pressing job

DENISON 1-ton hydraulic *MULTIPRESS*®

now gives you:

More production per hour with extremely fast cycle time . . . without kicking pedals or pulling levers.

Uniform quality production with accurately duplicated ram pressure on every stroke.

Maximum safety with interlocking controls to prevent accidental tripping.

THE
DENISON ENGINEERING COMPANY
1174 Dublin Road Columbus 16, Ohio
A Subsidiary of American Brake Shoe Co.

DENISON HydrOILics

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

MAIL DATA FORM
to see how you can benefit

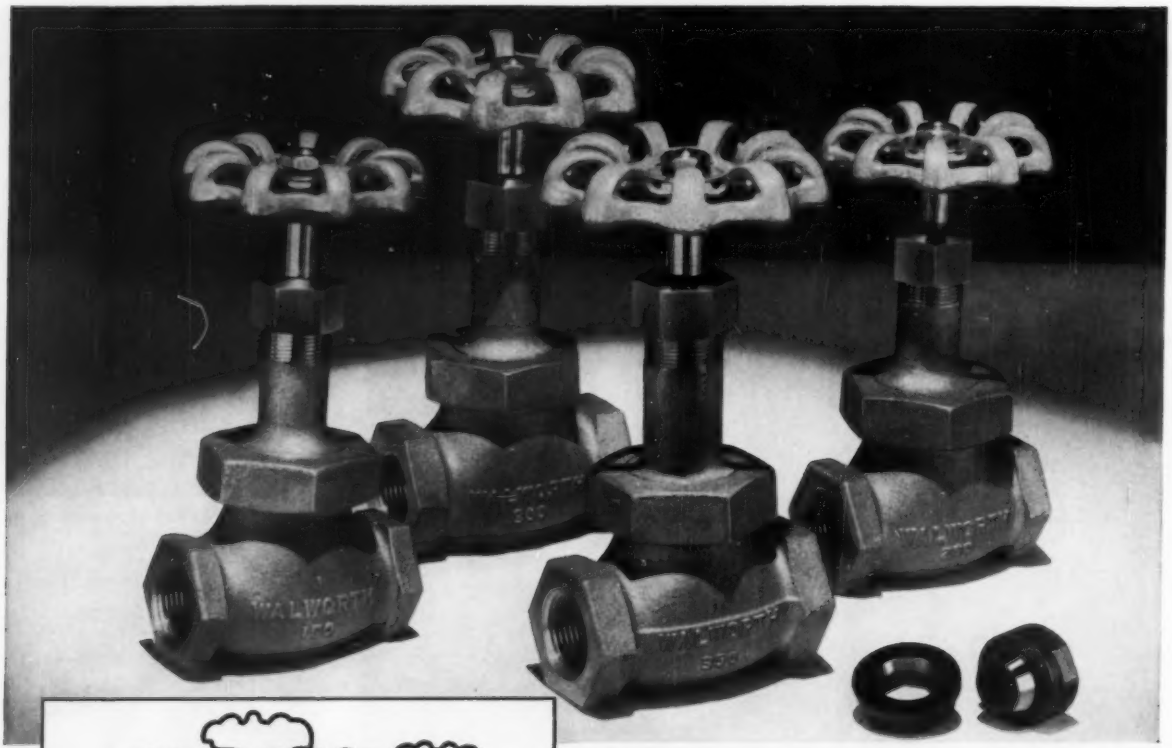
THE DENISON ENGINEERING COMPANY
1174 Dublin Road, Columbus 16, Ohio

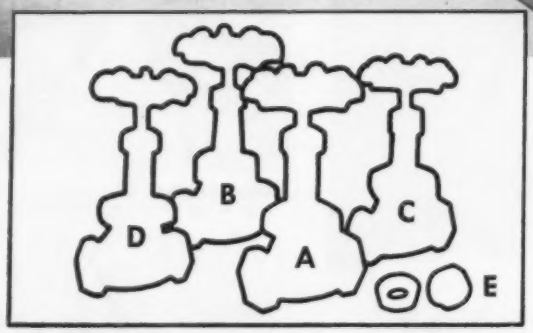
MY APPLICATION

Type of Operation	*Type of Material*
☐ Assembling	☐ Steel
☐ Marking	☐ Brass
☐ Punching	☐ Aluminum
☐ Trimming	☐ Plastic
☐ Broaching	☐ Glass

☐ Have Salesman Call

Company Name _____
Address _____
City _____ *Zone* ____ *State* _____
Your Name _____
Position _____





A — No. 225P.....350 WSP 550F, 1000 WOG
B — No. 260P.....300 WSP 550F, 600 WOG
C — No. 245P.....200 WSP 550F, 400 WOG
D — No. 237P.....150 WSP 500F, 300 WOG
E — "500 Brinell" Stainless Steel Plug Type Seat and Disc

Walworth offers four lines of Bronze Globe Valves with stainless steel, plug-type seats and discs. Advantages of these valves include:

• **Stainless Steel Plug-Type Seats and Discs,** heat-treated to a minimum of 500 Brinell hardness reduces wire-drawing to a minimum. Seats and Discs are machined and fitted simultaneously, assuring perfect mating.

• **Deep Stuffing Boxes with Glands** are fitted with reinforced, molded packing. Valves can be repacked under pressure when fully opened.

For Longer Bronze Valve Life . . .

"500 BRINELL" PLUG-TYPE STAINLESS STEEL SEATS AND DISCS

150 lb. 200 lb. 300 lb. 350 lb.

• **Oversize Stems,** made of high tensile strength silicon-bronze, assure long life.

• **Rugged Body Hexes,** are flat on top; do not interfere with wrench gripping body-to-bonnet union ring connection.

• **Bodies,** made of Composition M bronze (ASTM B61), have ample wall thickness to provide high safety factor.

• **Patented Handwheels** are air-cooled and designed with a "finger-fit grip." Makes turning easy even when wearing greasy gloves.

• **Identification Plates** secured by lock-washer under stem nut, show Figure Number of valves and make re-ordering sure and easy.

FOR COMPLETE INFORMATION, SEE YOUR WALWORTH DISTRIBUTOR OR WRITE FOR ILLUSTRATED CIRCULAR

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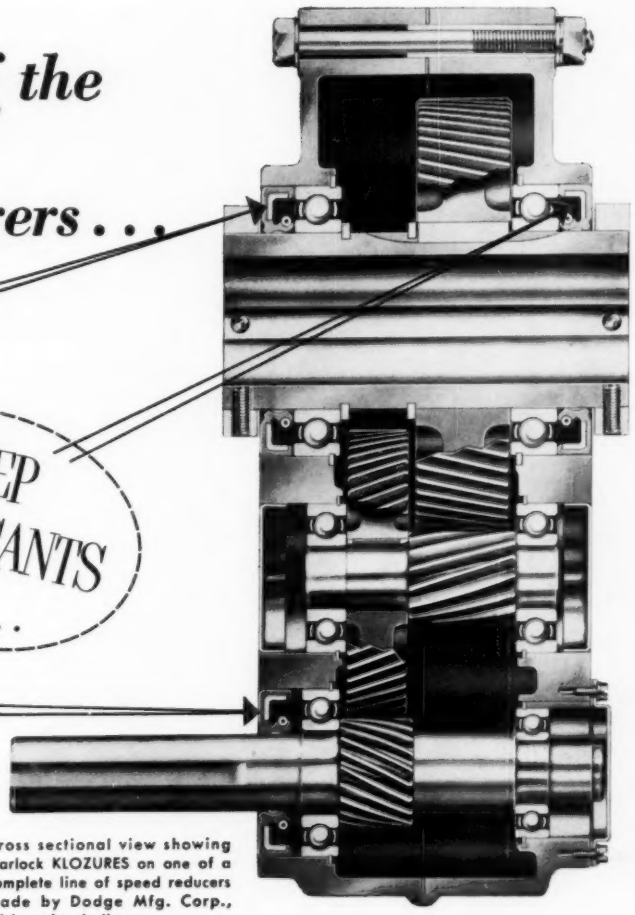
SUBSIDIARIES: ALOYCO ALLOY STEEL PRODUCTS CO. CONOFLOW CORPORATION M&H VALVE & FITTINGS CO. SW SOUTHWEST FABRICATING & WELDING CO., INC. WALWORTH COMPANY OF CANADA, LTD.

Over half the speed reducer manufacturers . . .

KEEP DIRT OUT . . .

KEEP LUBRICANTS IN . . .

WITH **KLOZURE*** **Oil Seals**



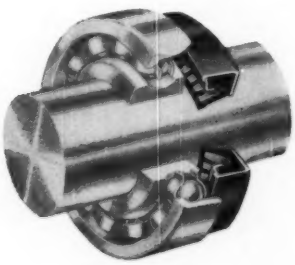
Cross sectional view showing Garlock KLOZURES on one of a complete line of speed reducers made by Dodge Mfg. Corp., Mishawaka, Indiana.

Makers of such fine precision products as The Dodge Torque-Arm Speed Reducer will not compromise when specifying oil seals. They know that the reputation of their entire product may depend on the quality of the oil seals they put in it.

Think about this the next time you have occasion to specify oil seals, and we think you'll choose Garlock KLOZURE Oil Seals—guaranteed to do the job you specify with minimum power loss and heat generation.

KLOZURES are available in a complete range of types and sizes. Therefore, be sure to call in one of Garlock's 125 trained sales engineers right at the start. His experience will save you time and money. Or, write today for Catalog No. 10.

**Registered Trademark*

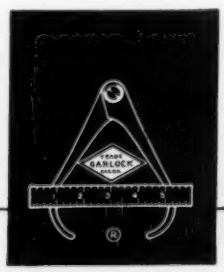


Model 53 finger spring KLOZURE for normal and high speed service, applied to a shaft to protect the ball bearing.

THE GARLOCK PACKING COMPANY, Palmyra, New York

For Prompt Service, contact one of the 30 sales offices and warehouses throughout the U.S. and Canada.

GARLOCK



Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints

GENERAL ELECTRIC ANNOUNCES . . .

NEW Industrial

Direct-current Motor

KINAMATIC* a new standard in direct-current motors, gives your machines wider speed ranges, greater output

To meet modern industrial needs for faster, more automatic, more continuous production, General Electric has designed an entirely new direct-current motor—the d-c Kinamatic.

Designed for Automation—Now, a direct-current motor has been designed for the modern job it has to do—either as individual motor drive or in regulating systems. The new General Electric d-c Kinamatic motor supplies the wide speed range and versatility required for today's manufacturing methods. It is designed for the close control of machines and split-second timing of processes essential to higher output.

Accelerated Production—The new d-c Kinamatic motor will modernize your equipment, give it increased power, higher speeds, greater output capacity. With the quick-acting G-E Kinamatic motor, your machines will process a greater variety of products . . . faster . . . easier . . . and with less maintenance and spoilage.

More Powerful—By combining advanced design with improved materials and manufacturing techniques, General Electric engineers have packed more power into the entire Kinamatic line. The powerful Kinamatic motor, with new stamina and durability, is ready to become one of your most effective weapons for keeping costs down, for meeting competition, for boosting productivity levels.

Engineering Help—Industrial specialists in 149 conveniently located General Electric Apparatus Sales Offices have the complete story on how the new d-c Kinamatic motors and generators can benefit your operation. For full details, contact your G-E Sales Representative, or write for Bulletin GEA-6355. *Direct Current Motor and Generator Department, General Electric Company, Erie, Pennsylvania.* 813-1

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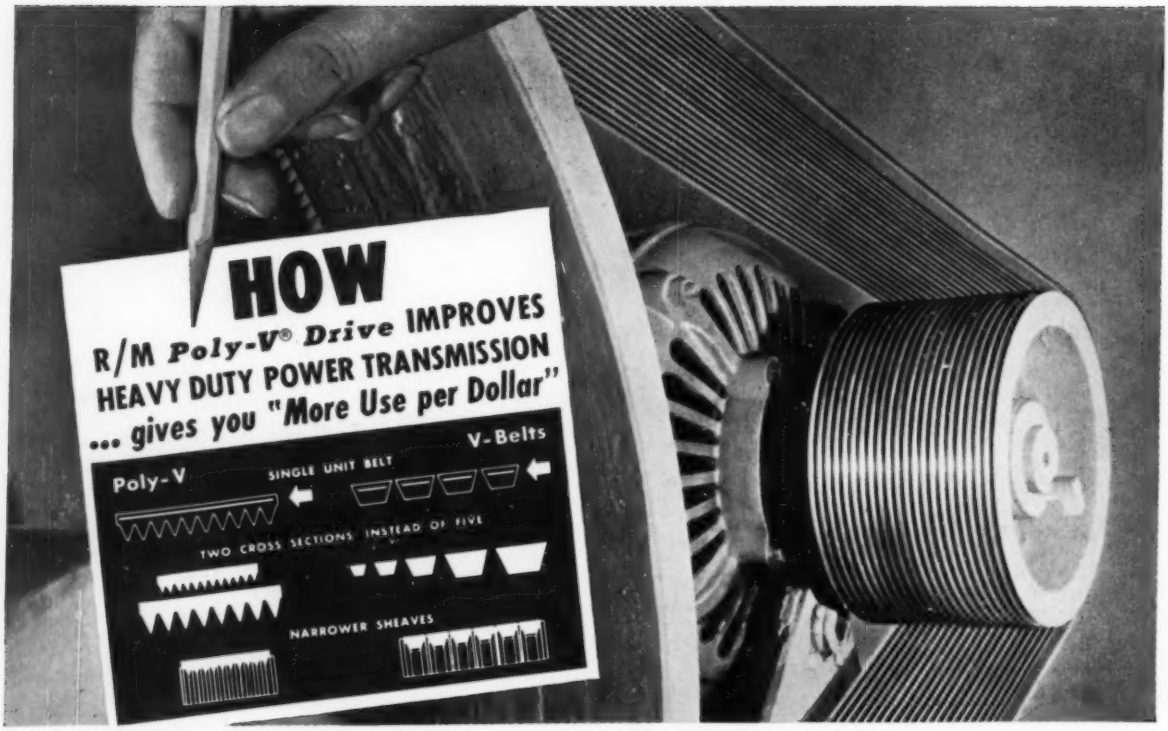
Progress Is Our Most Important Product

GENERAL ELECTRIC



Designers call R/M *Poly-V*® the "ideal" belt drive

Here it is . . . Raybestos-Manhattan's answer to design engineers' demand for a superior belt drive to simplify heavy duty power transmission. It's the patented R/M Poly-V Drive . . . the only completely new concept in power transmission which combines the strength and simplicity of flat belts and the high V grip and positive groove tracking of V-belts!

Why has it proved the "ideal" drive for a great variety of applications?

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Poly-V Drive maintains constant pitch diameter at all loads. No more sinking of belts in the sheave grooves: Poly-V belt speed ratio and belt position remain more constant from no load to full load to run smoother, cooler, with less wear on belt and sheaves. Just two cross sections of Poly-V Belt meet every heavy-duty power transmission requirement, as compared to five with V-belts. R/M Poly-V Drive cuts costly belt and sheave inventories to a new low!

R/M engineers who developed Poly-V Drive will be glad to give you further data on these and other advantages of this amazing new drive . . . and to work with you to determine the installation that will mean "More Use per Dollar" for your application. Contact an R/M representative . . . or write for a copy of Poly-V Drive Bulletin #6638.

CONDOR V-BELTS • R/M SUPER-POWER V-BELTS

Write for Bulletin #6868 on the complete line of Condor V-Belts for regular service on conventional V-belt drives. Also write for Bulletin #6628 on R/M Super-Power V-Belts with 40% more Horsepower capacity where needed.

*Poly-V is a registered Raybestos-Manhattan Trademark RM-628

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Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Laundry Pads and Covers • Bowling Balls

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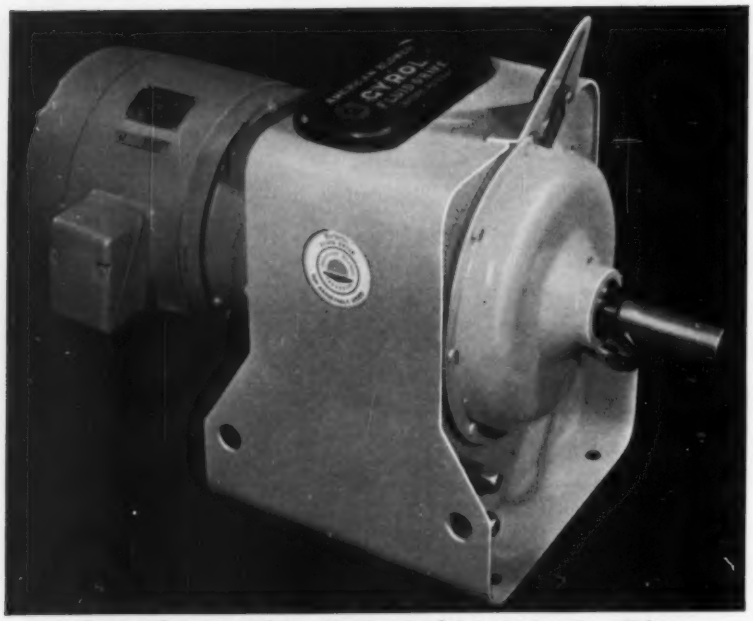
Why you should include Gýrol Fluid Drives in your plans for automation



Compact, flange-mounted Type VS, Class 2 Gýrol Fluid Drive — 1 to 25 hp.

For one thing, Gýrol Fluid Drives provide adjustable, *stepless* speed control of driven machinery, using *standard*, constant-speed motors — without complicated electric circuits or starting devices.

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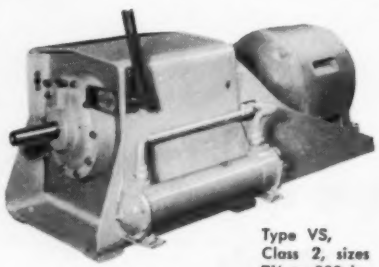

Type VS, Class 2, sizes 7½ to 800 hp.

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AMERICAN 75th ANNIVERSARY YEAR American Blower 1881 - 1956 **BLOWER**

FOR COMPLEX FABRICATION. In chemical plants, these Stainless Steel acid catchers are used to remove dilute sulfuric acid from gases. Continental Boiler & Sheet Iron Works in St. Louis fabricated the units. Notice the complicated curves in the helix plates, and the neat joinery . . . a tribute to fine craftsmanship and the workability of Stainless Steel.

FOR ABRASION AND CORROSION RESISTANCE. Oil can racks stand out in all kinds of weather, and the support strips are constantly rubbed and knocked by the heavy cans of oil. Modern Metal Products Company of Greensboro, N. C. makes the strips out of Stainless Steel so they will stay bright and new-looking, and never get banged out of shape.

NOTHING *can equal* *Stainless Steel*

In its combination of desirable properties

No other design material can match Stainless Steel in its combination of desirable properties: corrosion resistance, strength and hardness, beauty, cleanability and easy fabrication. When seeking a source of supply, remember that United States Steel offers you the widest range of types, finishes and sizes.

FOR SANITATION. These Stainless Steel shelves are made by the Eastern Steel Rack Company, Boston, Massachusetts, for use in cold storage rooms. They are easy to clean, and offer a sanitary, corrosion-resistant surface for food products of all kinds.

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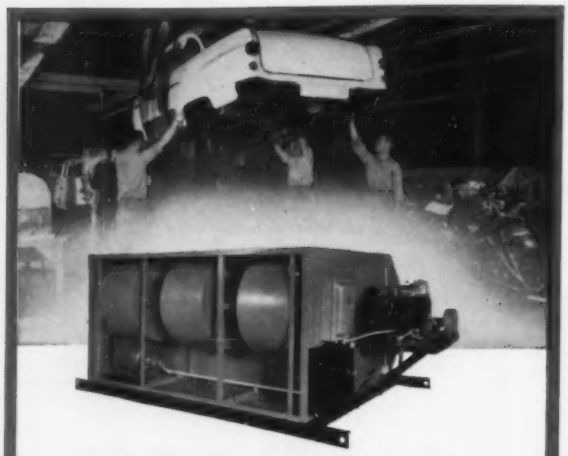
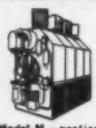


LEADING AUTOMOBILE MANUFACTURERS place their confidence in

NATIONAL Champion

DIRECT FIRED HEATERS

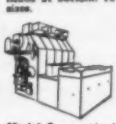


Model H—vertical unit with discharge heads. 12 sizes.

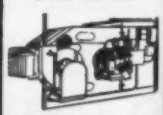
Model D—vertical unit for duct work. 12 sizes.

Model P—portable, vertical unit for flexible duty. 6 sizes.

Model R—inverted unit with discharge heads at bottom. 12 sizes.



Model S—vertical unit with side blowers to permit proper location of air mixing dampers. 12 sizes.



Model C—horizontal ceiling suspension unit for space saving. 12 sizes.

Where make-up air and tempering is a problem—a National Champion heater is your answer.

And where space is a prime consideration, the National Champion Model C horizontal ceiling suspension unit is unexcelled. No matter how large or small your plant may be, there's a National Champion heater designed to do the job with the utmost economy and efficiency. All National Heaters feature the lifetime "teardrop design" stainless steel combustion chamber. National Champions come in 6 models—66 sizes, from 200,000 to 2,000,000 BTU capacities. Check these outstanding features.

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Teardrop design Combustion Chamber the "heart" of National Champions

NATIONAL HEATER CO., INC.

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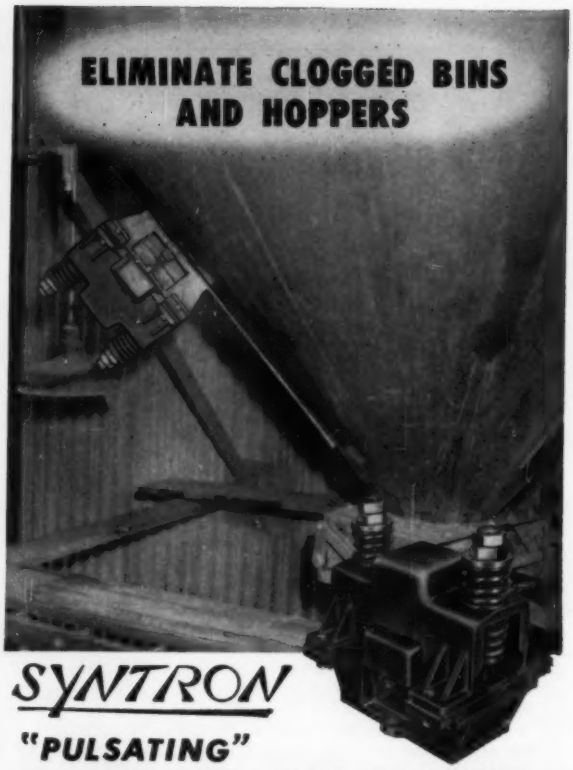

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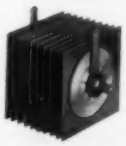
. . . Other Syntron Products that reduce production problems



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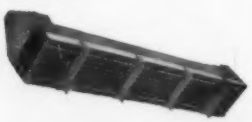

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For automatic, single file, oriented position feeding of parts at controllable rates.

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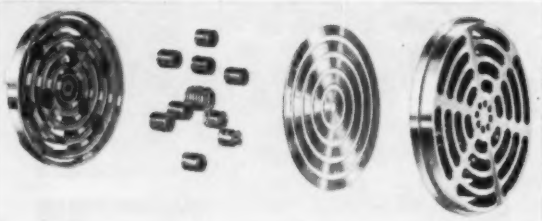
(AIR • GAS • AMMONIA)



Peak performance, maximum efficiency, greater output, and lower power costs can be built into your oldest, and of course your newest, compressors by the installation of VOSS VALVES.

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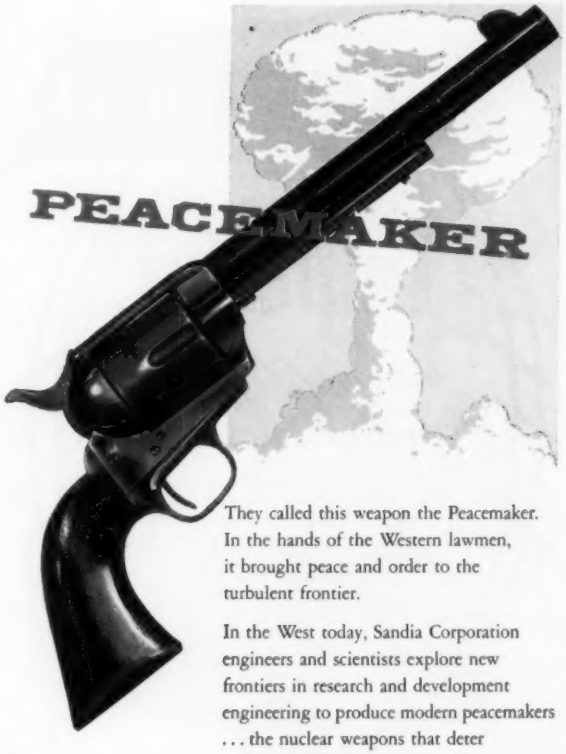

They called this weapon the Peacemaker. In the hands of the Western lawmen, it brought peace and order to the turbulent frontier.

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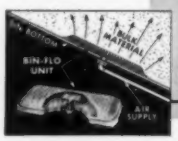
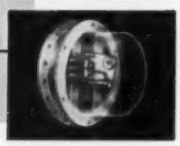


BIN-DICATOR

BIN-FLO AERATOR



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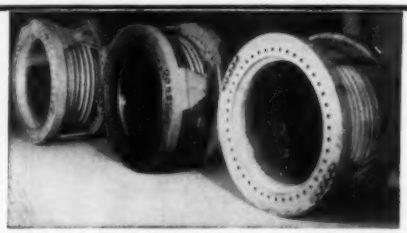
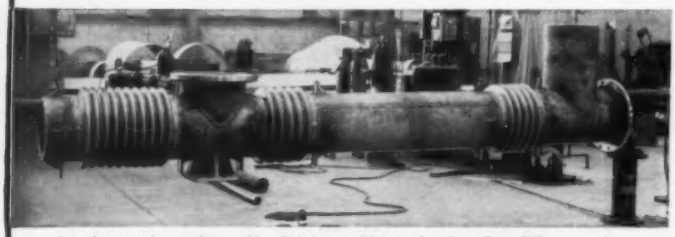


Three 48" Hinge-Type Corruflex Expansion Joints

ENGINEERING BACKS UP EVERY CORRUFLEX PACKLESS EXPANSION JOINT



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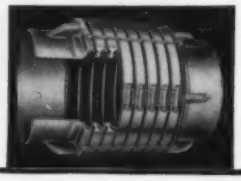

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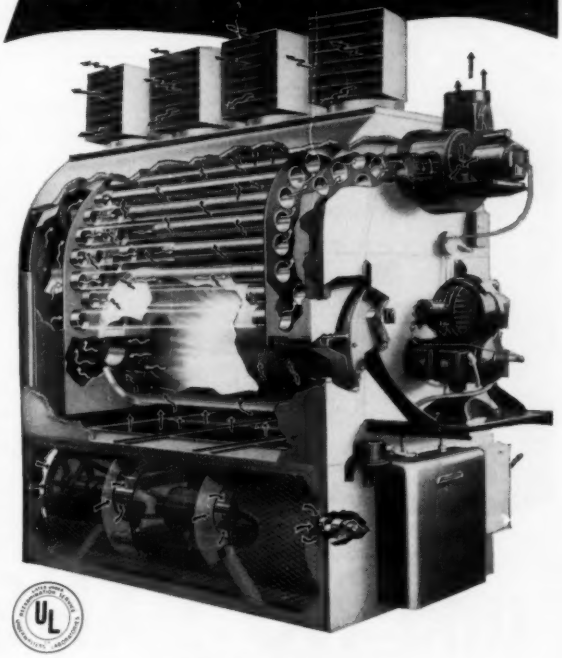

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300,000 BTU's TO 2,000,000 BTU's

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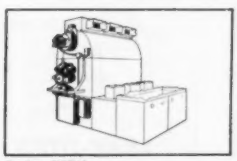

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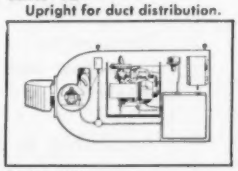
Upright for duct distribution.



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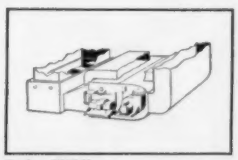

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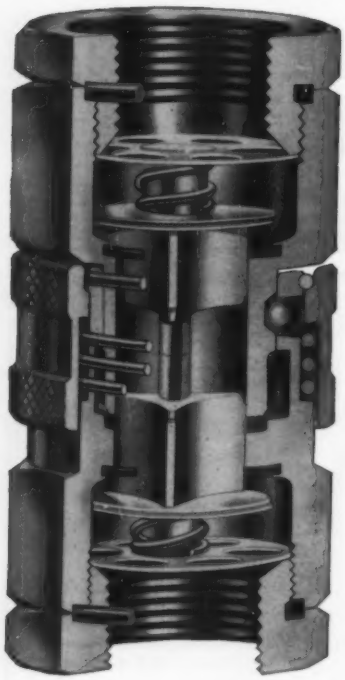

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Design Mechanical Portions of Aircraft Nuclear Power Plant Equipment

General Electric now offers the qualified engineer a rare opportunity to combine good judgment, sound engineering fundamentals and the ability to work with others. This is a career position in one of the latest aeronautical areas, aircraft nuclear propulsion. The working environment is excellent...the personal benefits, comprehensive.

The engineer who qualifies for this job will be responsible for the design and proper functioning of the mechanical portions of power plant equipment associated with both engines and reactors. This means he must have 3 to 8 years' experience in the mechanical design of lightweight, high temperature machinery, preferably experience in turbojet engines. An advanced degree is desirable.

Openings in Cincinnati, Ohio and Idaho Falls, Idaho

Address replies stating salary requirements to Location You Prefer...

W. J. Kelly
P. O. Box 132
Cincinnati, Ohio

L. A. Munther
P. O. Box 535
Idaho Falls, Idaho

GENERAL ELECTRIC

DEPARTMENT MANAGER SEAMLESS WELDING FITTINGS

Large established manufacturer has opening for a man, experienced in the production of seamless welding fittings, to assume complete charge and to develop and expand this departmental activity. Please supply full information on experience and expected remuneration.

Address CA-5708, % "Mechanical Engineering"

ASSISTANT MECHANICAL SUPT. MS. MECHANICAL OR ELECTRICAL ENGINEERING MARRIED—AGE 30–35

Very desirable staff position and promising career opportunity with large nitrate mining company in Chile, South America. Work will involve supervision of construction, repair and maintenance of large scale mine and plant equipment including diesel power plant units. Three year contract, attractive salary, fully paid transportation. Low cost living, healthful climate. Write fully, with small photo, giving educational background, experience and salary expected.

Address CA-5734, % "Mechanical Engineering."

MECHANICAL PLANT BETTERMENT ENGINEER

M. E. GRADUATE PREFERRED
5–15 YEARS' EXPERIENCE

Operation and betterment of steam electric plants. Diesel experience helpful. Permanent position.

Required by Operating Division of long established service and supervisory organization, for large group of Electric Utilities located eleven Latin American countries. Some travel. Location New York. Usual employe benefits. Reply giving age, education, experience, personal particulars and salary expected.

AMERICAN & FOREIGN POWER CO., INC. AND SUBSIDIARIES
2 Rector Street, New York 6, New York
21st Floor DI 4-4400 Ext 8494

THE APPLIED PHYSICS LABORATORY of the JOHNS HOPKINS UNIVERSITY

offers an exceptional opportunity to qualified men who want to advance themselves professionally in the GUIDED-MISSILE field. The Laboratory has a reputation for the recognition and encouragement of individual responsibility and self-direction.

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INTERNAL AERODYNAMICS AND PROPULSION
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STRESS ANALYSIS

Please send your resume to:
Professional Staff Appointments

APPLIED PHYSICS LABORATORY
THE JOHNS HOPKINS UNIVERSITY
8607 Georgia Avenue Silver Spring, Maryland

WANTED ASSISTANT CHIEF ENGINEER

Graduate Mechanical Engineer, or equivalent, with a minimum of three years' experience in high pressure power plant operation. A high caliber man is required in the operation and maintenance of 1250-pound pressure, pulverized fuel fired, steam-electric power plant located in the midwest.

Write stating education, experience, salary expected, and availability. All replies will be held confidential.

Address CA-5687, % "Mechanical Engineering."

It will pay you to read the announcements on these pages for an opportunity that you may be looking for or one that may be of interest to you.

Automotive Engineer

Laboratory Technical Service work on lubricants. Some experience in lubrication field preferred. Major Petroleum Company, New York City.

Address CA-5642, % "Mechanical Engineering."

engineers

DESIGN

At General Electric an expanding program has created excellent design opportunities in the areas of Nuclear Reactor facilities, Chemical Separations and Metal Fabrication plants.

In addition to training and experience, imagination and creativeness are prime requisites for fulfilling the growth potential inherent in these permanent positions.

The following unusual positions are now open in the areas of:

- Vibration and stress analysis of structures and complex equipment.
- Design of power plants (steam) and associated equipment including power system stability, heat transfer and turbine performance under varying pressure and flow conditions.
- Manufacturing equipment design and application including pumps, turbines and valves.
- Design control procedures, knowledge of design problems and ability to estimate costs.
- Design metallurgist, ferrous and non-ferrous alloys.

Also **Draftsmen** — Mechanical, piping and electrical.

Write in confidence to General Electric, the organization whose advanced "living-space" concept of human relations is designed to help you happily grow in your chosen field. Please include your experience, age, academic background and professional references. Personal interviews will be arranged with all selected candidates.

Mr. E. P. Galbraith
Technical Personnel Placement

GENERAL ELECTRIC
Richland, Washington

INSPECTOR ENGINEER

Graduate Mechanical Engineer with minimum 3 years' experience in work involving thorough knowledge of the materials and equipment used for oil producing, refining and supporting facilities. Knowledge A.P.I. and A.S.M.E. and other production codes required. For New York office, however, job requires extensive travel throughout the U. S. to inspect and approve purchased equipment and materials.

Salary commensurate with education and work experience. Liberal benefit program. Write outlining personal history and work experience.

Recruiting Supervisor, Box 115

ARABIAN AMERICAN OIL COMPANY
505 PARK AVENUE
NEW YORK 22, N. Y.

ENGINEERING OPPORTUNITY

Excellent opportunity for graduate mechanical or industrial engineer with long established, rapidly growing Midwestern company with national organization and AAA-1 rating.

35 to 40 years old; 10 years' experience required in plant and production engineering procedures, with background in compressed gas or related chemical industry preferred.

Candidate must have proven ability in writing, setting up and maintaining work standards, quality control and maintenance procedures.

Salary open. Will pay interview expenses. Replies confidential. Write

Personnel M-1
Puritan Compressed Gas Corp.
2012 Grand Avenue, Kansas City, Missouri

MECHANICAL ENGINEERS
(Ages 25-32)

Career opportunities with a major integrated U. S. oil company operating in South America. Position vacancies exist in an expanding organization for graduate mechanical engineers with 4½ to 6 years of experience. Activities include the design, installation and modification of compressors, turbines, hoists, pressure vessels, automatic controls, centrifugal and direct displacement pumps, etc. Salary, including bonus, $14,000. Liberal employee benefits and home vacations with travel expenses. Send complete resume of work experience and personal data. Interviews will be arranged for qualified candidates. Replies held in strict confidence.

Box 1221, Dept. T-13
New York 1, N. Y.

SENIOR MECHANICAL ENGINEER

To act as chief mechanical engineer for large engineering organization. Must be able to formulate fundamental investigative program in machine design and mechanisms development. Work will consist of the analysis and development of complex mechanical systems.

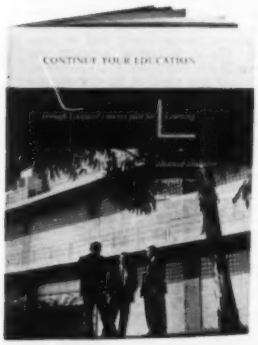
Send Complete Resume to Box CA-5694,
care of "Mechanical Engineering."

Answers to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

to career-conscious **ENGINEERS:**

CONTINUE YOUR EDUCATION...

. . . at little or no cost to you at U.S.C., U.C.L.A. *and* LOCKHEED



Engineers interested in advancing their education and career will find Lockheed's new brochure, "Continue Your Education" of interest. It details day and evening programs open to engineers at the University of Southern California, University of California at Los Angeles and at Lockheed. Coupon below is for your convenience in requesting the brochure.

The work of today's aircraft engineer is becoming ever more complex.

His position and career require constantly increasing theoretical and practical knowledge. His intellectual and professional curiosity demand educational growth.

This "need to know" is welcomed at Lockheed. It is a vital factor in Lockheed's engineering leadership. It is the basis of untold engineering achievements.

To help engineers in their quest for knowledge, the California Division of Lockheed has developed a comprehensive series of training and scholarship programs. They are adapted to Lockheed engineers in all fields, at all levels.

Within this Master Plan for Learning, every engineer will find a program best adapted to his requirements.

To engineers who lack aircraft experience.

Aircraft experience is not necessary to join Lockheed. It's your engineering training and experience that count. Lockheed trains you for aircraft engineering—at full pay.

California Division

LOCKHEED

Aircraft Corporation

Burbank, California

Mr. E. W. Des Lauriers, Dept. CE-4-6
Lockheed Aircraft Corporation
Burbank, California

Please send me a copy of your brochure, "Continue Your Education."

My name _____

My home address _____

My field of engineering _____

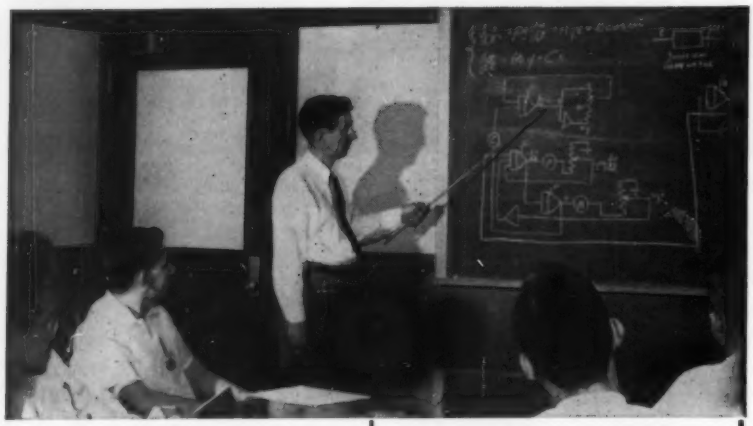
My home phone _____

My city and state _____

Experience Pays Off at

Bendix

GUIDED MISSILE SECTION



Unusual Job Opportunities for:

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Experienced engineers required for design of precision electronic and electro-mechanical automatic test equipment and instrumentation. Programming, signal generation from low frequency to microwave, analogue and digital data handling, and go-no-go comparators and indicators are involved.

ELECTRONIC GUIDANCE

Senior Electronic Engineers are needed to design and develop guidance systems for a major guided missile project. Backgrounds in microwave, radar and servo systems are required.

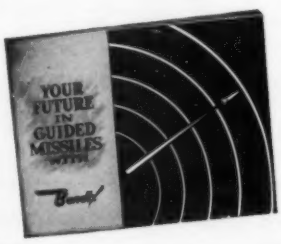
Senior Mechanical Engineers are needed to design and develop electronic packaging for complex missile guidance systems.

SYSTEMS ANALYSIS

Senior Engineers are needed with extensive backgrounds in the over-all dynamic behavior of missiles and weapons systems, as well as airframe systems of a missile, particularly in terms of weapon performance, to work with analogue computers, digital differential analyzers, breadboards, prototypes of missiles and missile equipment, and special mechanical and electronic simulators. Experience with aerodynamics, servo-mechanisms, electronics, heat transfer, stress analysis, shock and vibrations is desirable.

Bendix Guided Missiles offer interesting job opportunities for Senior Engineers, Assistant Engineers, Junior Engineers and Technicians.

A thirty-six page book, "Your Future in Guided Missiles", describing in detail the many phases of our guided missile operation and the job opportunities available to you, will be sent to you on request. Write for your copy today. BENDIX PRODUCTS DIVISION—MISSILES, 409F, Bendix Drive, South Bend, Indiana.



VISCOSE RAYON

CHIEF ENGINEER—Graduate Mechanical Engineer with at least 10 years' experience in Rayon Industry, preferably in staple, to take over-all charge of Engineering Department of smaller rayon plant. Scope of position covers maintenance, power, design and construction. Administrative ability required.

Please send full resume and salary requirements to:

Hartford Rayon Company
Division of Bigelow-Sanford Carpet Co.
Rocky Hill, Connecticut

MECHANICAL EQUIPMENT SPECIALIST

Graduate Mechanical Engineer with a minimum of 7 years' experience in the selection, design, operation and maintenance of heavy industrial mechanical equipment. This includes Diesel engines, compressors, pumps, turbines, and other related machinery for oil refinery, power plants and oil producing facilities. Good industrial contacts required. For New York Engineering Department, but job requires occasional travel to Europe and the Middle East.

Salary commensurate with experience and training. Liberal benefit program. Write outlining personal history and work experience.

Recruiting Supervisor, Box 113

ARABIAN AMERICAN OIL COMPANY
505 PARK AVENUE
NEW YORK 22, N. Y.

Engineer, ME, EE

Nuclear Reactor Design for Aircraft

A long-range well-paid career position in the highly promising new field of aircraft nuclear propulsion, is now open with General Electric. This position will appeal to the qualified engineer whose creative fluency keeps him abreast of the many unusual design problems that he will encounter.

Requirements include a B.S. or advanced degree in mechanical or electrical engineering, plus familiarity with fluid flow, heat transfer, stress, etc. Some knowledge of fabrication processes and techniques is preferable.

Publication of research results in the appropriate classified or open literature is encouraged.

OPENINGS AT CINCINNATI, OHIO AND IDAHO FALLS, IDAHO

Address replies stating salary requirements to location you prefer

W. J. Kelly
P. O. Box 132
Cincinnati, O.

L. A. Munther
P. O. Box 535
Idaho Falls, Idaho

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ENGINEERS

Be certain *you*

MAKE THE *RIGHT* CHOICE!

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ASK YOURSELF THESE QUESTIONS —IT WILL PAY YOU.

CHALLENGING OPPORTUNITIES IN

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AVIONICS

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INERTIAL SYSTEMS

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JET ENGINE FUEL CONTROLS

with AC ELECTRONICS DIVISION OF

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Flint 2, Mich. and Milwaukee 2, Wis.

Whether a Recent Graduate making his first choice or a veteran Engineer seeking that permanently RIGHT position, ask yourself the following questions:

MY TALENTS ARE BEST SUITED FOR?

Engineers come all sizes, shapes and potentials. G.M.'s policy of decentralization creates individual opportunity for development and advancement.

STARTING WAGE? POTENTIAL EARNINGS?

At G.M. these two questions are best answered by another question—"How high is up?" Earnings both present and future are entirely dependent upon you. At AC you determine your earnings.

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AC has been designated the official ELECTRONICS DIVISION for *all* General Motors Divisions. We are permanently dedicated to the research, development and manufacture of things Electronic . . . making America so it's safer and better.

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At AC you enjoy working with the latest and the finest of equipment and with the top men in the field.

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Are the finest possible in Milwaukee, America's most progressive town combining big town cultural and civic advantages with small town hospitality. "An ideal town for ideal family living."

WHAT CAN AC DO FOR ME?

Write us in strictest confidence . . . you will hear from us by return mail. Send us the coupon below . . . YOUR FUTURE DEPENDS UPON IT.

AC The Electronics Division
General Motors Corporation, Milwaukee 2, Wis.

Send me full particulars about AC ENGINEERING OPPORTUNITIES

☐ So you can better "tailor make" your offer to me I have attached a resume of my education and/or work experience.

☐ I will send it at a later date.

Name_____

Address_____

City_____ Zone_____ State_____

Opto-Mechanical Engineers... to $11,000 ...Openings in Florida!

You will be intrigued by the problems in determining systematic and variable error in optical instruments, such as motion picture cameras, and tracking telescopes related to acquisition of missile test data.

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Ideal living and working conditions on Florida's Central East Coast with leading electronics firm whose reputation is world wide.

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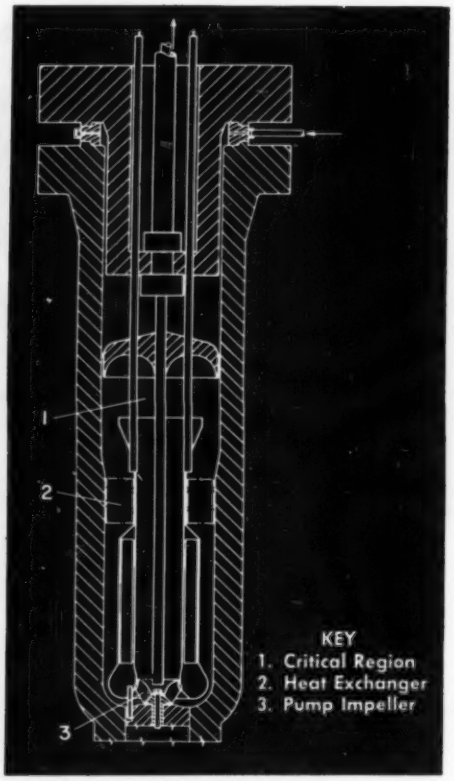
To arrange confidential interview, send resume to Box CA-5706, care of "Mechanical Engineering."

1 of 5



This simplified drawing of an experimental homogeneous type power reactor, now in the final assembly stage, shows one of five nuclear reactor projects currently under way at Los Alamos, where the world's first homogeneous reactor was designed and built and is still in operation.

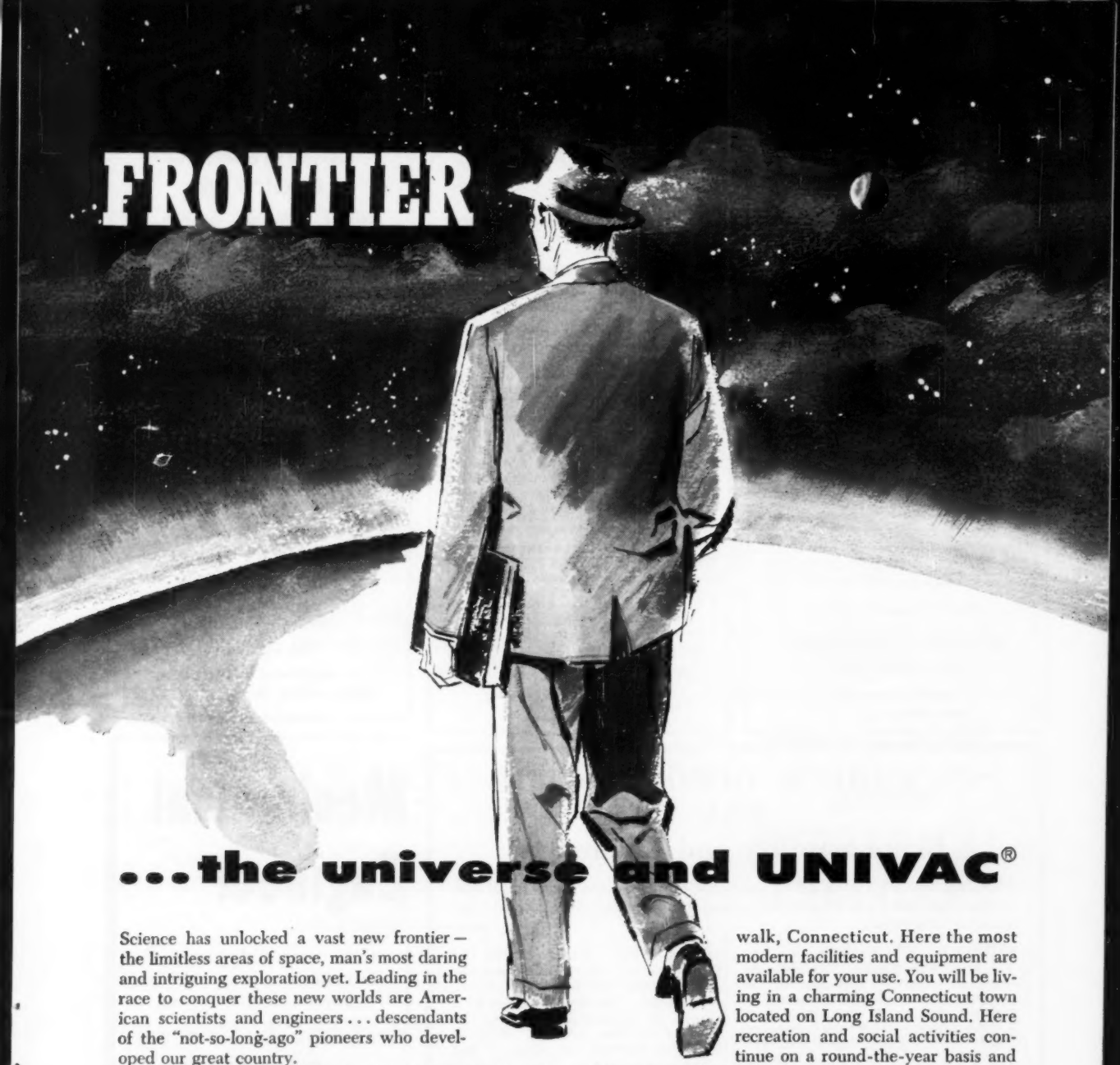
Indicative of the importance of these experiments is the Laboratory's thirteen year record in active research, design and development in this major field of basic scientific interest.

Many challenging projects in nucleonics, physics, chemistry, metallurgy, mathematics and engineering support these as well as other of the Laboratory's diverse activities.

Top-level scientists and engineers interested in long-range career opportunities at one of the nation's foremost scientific laboratories can secure complete information by writing

DEPARTMENT OF SCIENTIFIC PERSONNEL
Division 907

los alamos
scientific laboratory
OF THE UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO



...the universe and UNIVAC®

Science has unlocked a vast new frontier — the limitless areas of space, man's most daring and intriguing exploration yet. Leading in the race to conquer these new worlds are American scientists and engineers . . . descendants of the "not-so-long-ago" pioneers who developed our great country.

The scientists and engineers at Remington Rand Univac are leading the field and are part of the team that is setting "*new* standards for others to follow."

Because of these great new opportunities many openings have been created at our laboratory at South Norwalk, Connecticut. Here the most modern facilities and equipment are available for your use. You will be living in a charming Connecticut town located on Long Island Sound. Here recreation and social activities continue on a round-the-year basis and there are excellent education facilities for your children.

At South Norwalk we have immediate openings for Mechanical and Electro-Mechanical Engineers with a bachelor's degree in *Engineering*. Extensive mechanical design background may substitute for some college. Men selected will do basic preliminary design and layout of small mechanisms. Work will require the development of original ideas and the ability to apply logical analysis to design problems.

Send complete resumé to

Remington Rand Univac

DIVISION OF SPERRY RAND CORPORATION

Attention Mr. A. L. Crable

Wilson Avenue • South Norwalk, Connecticut

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STEAM POWER ENGINEER

Steam Power Engineer for large New England utility. Attractive permanent position open for mechanical engineering graduate with broad background of responsible design experience in modern steam power generation who has served as Principal Project Engineer for two or more public utility steam power plant developments of 75,000 KW or greater capacity. Age range 40–50.

Address CA-5681, % "Mechanical Engineering."

STAFF ENGINEER

Degree in Chemical or Mechanical Engineering. 8–10 years' industrial experience with broad background in chemical plant design, erection and economics. Please send resume of experience, education, personal history and salary desired to

Personnel Supervisor,

American Potash & Chemical Corp.
Trona, Calif.

REFRIGERATION AND AIR CONDITIONING ENGINEER

Graduate M.E. with minimum 8 years' broad experience in refrigeration and air conditioning design and project work. To render technical service to operating units and serve as staff consultant on air conditioning and refrigeration problems related to overseas operations located in Saudi Arabia.

Facilities include large central air conditioning plant with chilled water distribution system through entire communities for residential and industrial air conditioning totaling 14,000 tons capacity, plus 700 tons of refrigeration for manufacture of ice and storage of commissary supplies.

Must be capable of developing and carrying work assignments to completion. For assignment in New York Engineering Office; occasional field trips required.

Write outlining work experience and personal history.

Recruiting Supervisor, Box 123

ARABIAN AMERICAN OIL COMPANY

505 PARK AVENUE
NEW YORK 22, NEW YORK

AREA ENGINEERS

Several graduate engineers with minimum 5 years' experience supervising maintenance engineering functions in oil refining or producing facilities, power plants, heavy industrial installations, manufacturing plants or related operations. To establish technical supervision, procedures, maintenance operations, and schedule routine and special work for major oil producing and refining operation with all supporting facilities; i.e., housing, feeding, recreation, etc.

Salary commensurate with background and experience. Write giving full particulars regarding personal history and work experience. Please include telephone number.

Recruiting Supervisor, Box 66

ARABIAN AMERICAN OIL COMPANY

505 PARK AVENUE
NEW YORK 22, N. Y.

SALES AND APPLICATION ENGINEERS

If you are a graduate engineer interested in sales and application engineering of centrifugal pumps, rotary pumps, gears, centrifugal compressors or steam turbines, and would like to become part of an expanding and aggressive sales organization, send us your experience resume.

Excellent opportunities exist for qualified men, and salary is commensurate with ability and experience.

Employee benefits are of considerable value, and most important—you will be working with a team of friendly, cooperative associates.

APPLY:

De Laval Steam Turbine Company
853 Nottingham Way
Trenton, New Jersey

SIX CAREER OPPORTUNITIES With Responsibility and Challenge

The Parkersburg Rig & Reel Company, manufacturers of oil and gas equipment, have six long-range positions immediately available for qualified engineers.

CHEMICAL ENGINEERS (2) You will work with a small development-team of engineers. Your job will be the improvement of existing apparatus and the design and development of new equipment. As we see it, you are ideally suited for this work if you have 3 to 10 years', or more, oil-country experience as a gas engineer or process engineer. Your desire to tackle problems of adsorption, heater design, and vapor-liquid separation will count heavily.

MECHANICAL ENGINEERS (2) Here, too, you will work as a member of a small, fast moving development group on the improvement of present apparatus and the design and development of new products. You should have 1 to 5 years' oil-country experience in pressure-vessel design, piping systems, or the mechanical aspects of oil production equipment.

APPLICATION ENGINEERS (2) This work is a part of a product-service group within an engineering department. You should have a keen interest in applying apparatus to the needs of the lease operator. You will be a link between the salesman and the engineering group. Technical writing is a part of the work. For this job, we believe you should have from 2 to 10 years', or more experience with oil-country equipment. Some of this time might well have been in sales-work.

If these openings interest you, please send us a resume of your experience. We will reply promptly and your application will be held in confidence. Salaries for these positions are open and will depend upon your experience and ability.

Address your reply to

THE PARKERSBURG RIG & REEL COMPANY,
Box 13295, Houston 19, Texas.

Mechanical Engineer

High level staff position for mechanical engineer with extensive experience in one of the following fields:

AIRCRAFT CONTROLS
AIRCRAFT HYDRAULICS

The engineers selected for these two positions will have top staff authority and responsibilities.

Contact: **J. J. Holley**

MARTIN

Baltimore 3, Maryland

"OPPORTUNITIES" 157-174

MECHANICAL ENGINEERS

Engineering graduates for product design and application. Products are vibration and shock isolation systems on aircraft, electronic, automotive, marine, general industrial equipment. This is a rapidly expanding industry. Excellent long range possibilities for engineers who are interested primarily in design work. Duties also involve extensive liaison between and among field engineering, manufacturing, and research.

BOX 369, ERIE, PENNSYLVANIA

MACHINE DESIGNER

Excellent opportunity for creative thinking. Scope to carry thru to completed equipment on automatic mechanical and hydraulic plant machines. Located in the 3/4 million population Denver region, yet only 1 hour to Colorado rockies' hunting, fishing and skiing areas.

Coors Porcelain Co., Golden, Colorado

MECHANICAL ENGINEER

Graduate mechanical engineer interested in power plant design work. Experience not required. Excellent opportunity with consulting engineering firm in the Middle West. Liberal benefit plans and good working conditions.

Send resume of education and experience with statement of salary requirements.

Address CA-5721, % "Mechanical Engineering."

MECHANICAL RESEARCH ENGINEER

Graduate engineer with experience desired for research on mechanisms in motion picture, lithographic and photographic industries. Send half-page resume to

Director of Research
TECHNICOLOR MOTION PICTURE CORPORATION
2800 W. Olive Avenue
Burbank, California

APPLICATION ENGINEER

We have an opening for a graduate mechanical engineer with 3 to 5 years' experience preferably in air-handling problems. The responsibilities will be great, the assignments varied. The opportunities are unlimited for the right man. Please include a personal resume in full detail with your reply. Replies handled in strictest confidence.

CAMBRIDGE FILTER CORPORATION
738 Erie Blvd., East
Syracuse, N. Y.

VISCOSE RAYON

DESIGN AND PROJECT ENGINEER — Graduate Mechanical Engineer, 3–5 years' experience in Rayon or Chemical Industry, to be in charge of Design and Drafting Office in the Engineering Department or smaller rayon plant. Scope of work covers machinery — piping — and building — design, equipment layouts, engineering calculations and estimates.

Please send full resume and salary requirements to:

Hartford Rayon Company
Division of Bigelow-Sanford Carpet Co.
Rocky Hill, Connecticut

MECHANICAL ENGINEERS

Research and Development

Interesting positions open for Mechanical Engineers on a wide variety of projects in the following fields:

Heat Power Equipment — **Fluid Mechanics**
Thermodynamics — **Heat Transfer**

M.S. to Ph.D. in Mechanical Engineering with three to five years' experience in one of these fields essential. These positions offer an opportunity to use your initiative and creative ability. We offer excellent employee benefits including tuition-free graduate study. Please send complete resume to:

Mr. J. A. Metzger
ARMOUR RESEARCH FOUNDATION
of
Illinois Institute of Technology
10 West 35th Street
Chicago 16, Illinois

Procter & Gamble needs MECHANICAL ENGINEERS

(Graduated within last 10 Years)

- Permanent positions in Mechanical Research and Development, Process Equipment Design and Application, Heat and Power Equipment Design and other Engineering Fields.
- Salaries commensurate with education and industrial experience.
- Opportunities to grow with a leading chemical processing company—rated as one of the nation's three best-managed companies by the American Institute of Management.

For application form and further information write

Mr. J. E. Gale
Head of Employment
Engineering Division
The Procter & Gamble Company
Cincinnati 17, Ohio

MECHANICAL ENGINEERS
A Career With . . . *Linde*

IN LIQUID NITROGEN

Unusual and challenging career openings are offered in liquid nitrogen APPLICATION DEVELOPMENT

- **indefinite preservation and processing of biological materials.**
- **design of liquid nitrogen vacuum insulated containers.**
- **application of extreme pressures and low temperature.**
- **application of liquid nitrogen temperature in the shipment of frozen foods without intransit refrigeration.**

The magnitude and diversity of LINDE products and processes are appealing to Mechanical Engineers who are seeking employment with a dynamic company of proven stability

Bachelors or Masters are invited to investigate

LINDE AIR PRODUCTS COMPANY
a division of
UNION CARBIDE AND CARBON CORPORATION
Send resume to: Mr. P. I. Emch
P. O. Box 44, Tonawanda, New York
Refer to ad: ME-N

Fort Wayne, Ind.
"America's Happiest City"

Dear Bill:

Now that Joe is on the team here at Farnsworth, he's asked me to write and give you the same story that got him interested in coming with us.

Actually, Bill, it wasn't a "story." Just a few honest-to-goodness reasons why he and Marge should make the move and let the family really live as well as let Joe grow professionally.

For instance, do you know what "sold" Marge? The fact that in living here you are only 10 minutes from everywhere—schools, churches, stores etc. and Joe goes home for lunch every day instead of week-ends. She also liked the idea of some 300 lakes within 70 miles. (Guess where they're planning to spend the summer!)

As for Joe, he's all hepped up about the work he's doing on such missiles as Bomarc, Talos, Terrier and others. Says the top-notch scientists and engineers he's working with are all big-league and he's on the team.

That's about it, Bill. An engineer with your talents shouldn't be wasting around when he can get in on the ground floor here at Farnsworth in research, development or production engineering in missile guidance and control, radar, microwaves, test equipment, countermeasures, transistor applications etc.

So—why not write, right now to Don Dionne, Farnsworth Electronics Co. Fort Wayne, Ind. (a division of International Telephone and Telegraph Corp.)

You, Joe, I and Farnsworth will be mighty glad you did.

Sincerely, Jack

MACHINE DESIGNERS AND ENGINEERS

Machine designers and design engineers wanted for permanent positions. Design experience desired in either paper converting machinery, box manufacturing equipment or packaging equipment. Excellent working conditions and opportunity for advancement.

Address CA-5647, % "Mechanical Engineering."

CHIEF PRODUCT DEVELOPMENT ENGINEER

Long established and expanding manufacturer of consumer and industrial steel products seeks mechanical engineer experienced in product design and development. Age to 40. Starting salary $12,000 to $15,000. Submit complete resume to

Address CA-5737, % "Mechanical Engineering."

MECHANICAL ENGINEERS

Several excellent opportunities available with major producer of synthetic fibers and films. Openings are current in plant engineering departments in Pennsylvania, Virginia, and West Virginia.

Graduate mechanical engineers with 0–5 years of experience in machine and equipment design, mechanical layout, engineering maintenance, or related activities are invited to reply.

Please send resume including details of education, experience, and salary requirements to:

Personnel Recruitment Department
AMERICAN VISCOSE CORPORATION
1617 Pennsylvania Boulevard
Philadelphia 3, Pennsylvania

It will pay you to watch the announcements on these pages for an opportunity that you may be looking for or one that may be of interest to you.

LOCKHEED in GEORGIA MOVES AHEAD AGAIN!

Staff of 500 Seen For A-Plane Plant

W. R. Rhoads to Head Dawsonville Project, To Be Biggest of Its Type in Nation

Lockheed Aircraft Corp., wasting no time in the development of nuclear aircraft testing facilities at Dawsonville, announced Tuesday that W. R. Rhoads will head up the Dawsonville project.

Mr. Rhoads, who lives at 120 Osner Dr., NE, is chief staff engineer at Lockheed's Marietta plant now. He has been with Lockheed since 1941.

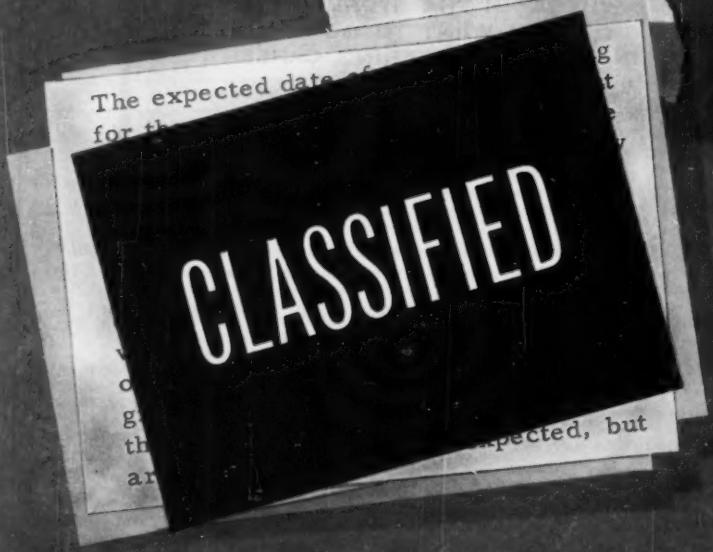
He will direct the work of the approximately 500 scientists, engineers and service personnel who will be employed at the Dawsonville site.

LOCKHEED AND the Air Force officially announced Monday night at a dinner at Gainesville that they intend to build a 10,000-acre, multi-million-dollar nuclear aircraft test site just southwest of Dawsonville (population, 350).

And, perhaps as significantly, Lockheed's top Georgia executive hinted that the actual manufacture of a nuclear-powered plane—perhaps the world's first—might take place at Lockheed's Marietta plant.

AND

there's more that can't be published—yet



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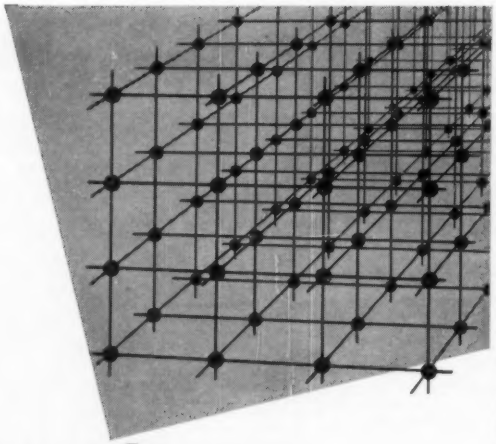

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RADIO'S ONE-WAY STREET

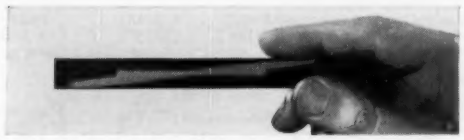
Dr. S. Weisbaum assembles an isolator which he developed for use in a new microwave system. Dr. Weisbaum is a Ph.D. in microwave spectroscopy from New York University. He is one of many young men at Bell Laboratories applying the insight of the physicist to develop new systems of communication.

New radio relay systems for telephone and television now in the making will employ an ingenious device invented by Bell scientists. The device, known as an "isolator," senses which way microwaves are traveling through a waveguide, and stops those going the wrong way.

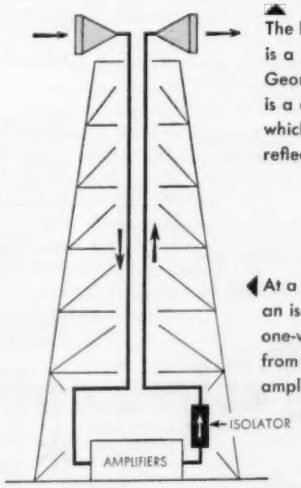
In the new systems a klystron wave generator sends signals through a waveguide to the antenna. The klystron must be shielded from waves reflected back along the waveguide by the antenna. The isolator stops reflections, yet allows the transmitted signals to go through clear and strong.

This isolator is a slab of ferrite which is mounted inside the waveguide, and is kept magnetized by a permanent magnet strapped to the outside. The magnetized ferrite pushes aside outgoing waves, while unwanted reflected waves are drawn into the ferrite and dissipated. This "field displacement" action results from the interplay between microwaves and a ferrite's spinning electrons. Bell physicists discovered this action during their fundamental studies of ferrites.

This is another example of how Bell Telephone Laboratories research works to improve American telephony and telecommunications throughout the world.



The heart of the isolator is a ferrite slab. Geometric pattern is a carbon layer which dissipates reflected signals.



At a radio relay station an isolator assures one-way transmission from the output of the amplifier to the antenna.

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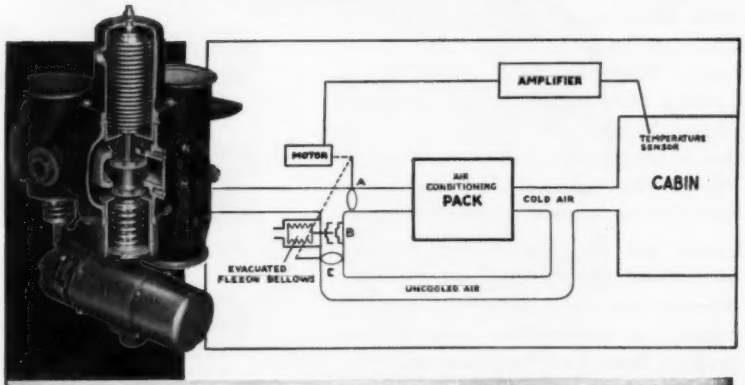
FLEXON® BELLOWS *Design Briefs*

Flexon® Bellows Governs Complex Air Conditioner Air Flow Valve



HOW IT WORKS

Valves A and C are connected by linkage and operated by an electric motor controlled by a temperature sensor to maintain a balanced flow of air through the conditioner and the by-pass. When Valve A opens, Valve C closes and vice versa. The Flexon Bellows actuates Valve B to regulate total air flow.

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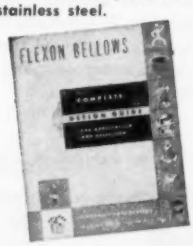

The Flexon Bellows Design Guide gives valuable application and design information. Write for your copy, today.

A Flexon Bellows is the heart of a mass flow valve manufactured by Stratos Division of Fairchild Engine and Airplane Corp., Long Island, N. Y.

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B-34

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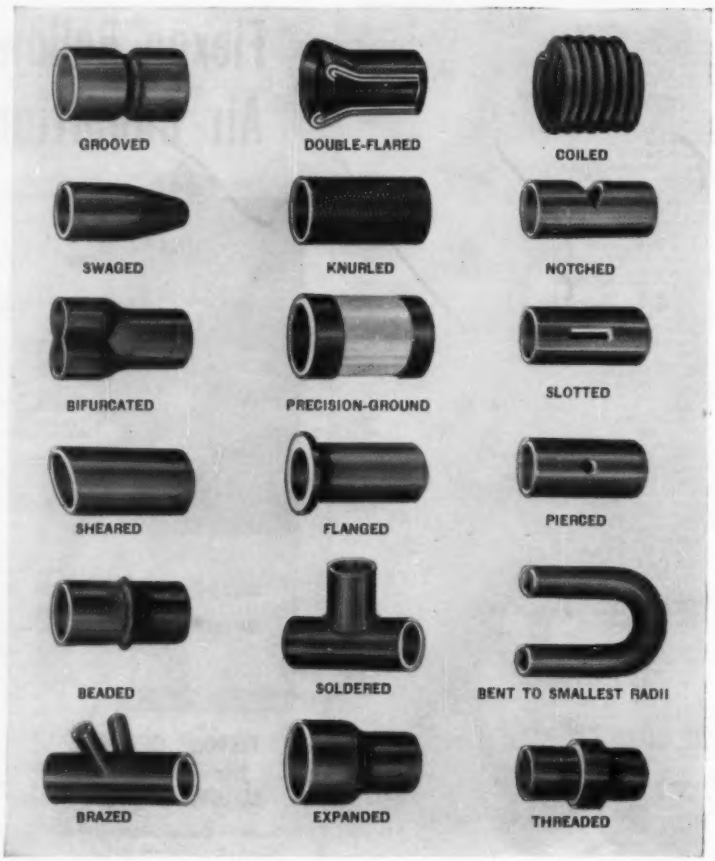

Shown above are but a few of the fabrication operations which are possible with Bundyweld Steel Tubing. Many of these, and others not shown, were developed through solving a specific problem brought to us by a customer or prospect. Bundy invites you to avail yourself of this design service.

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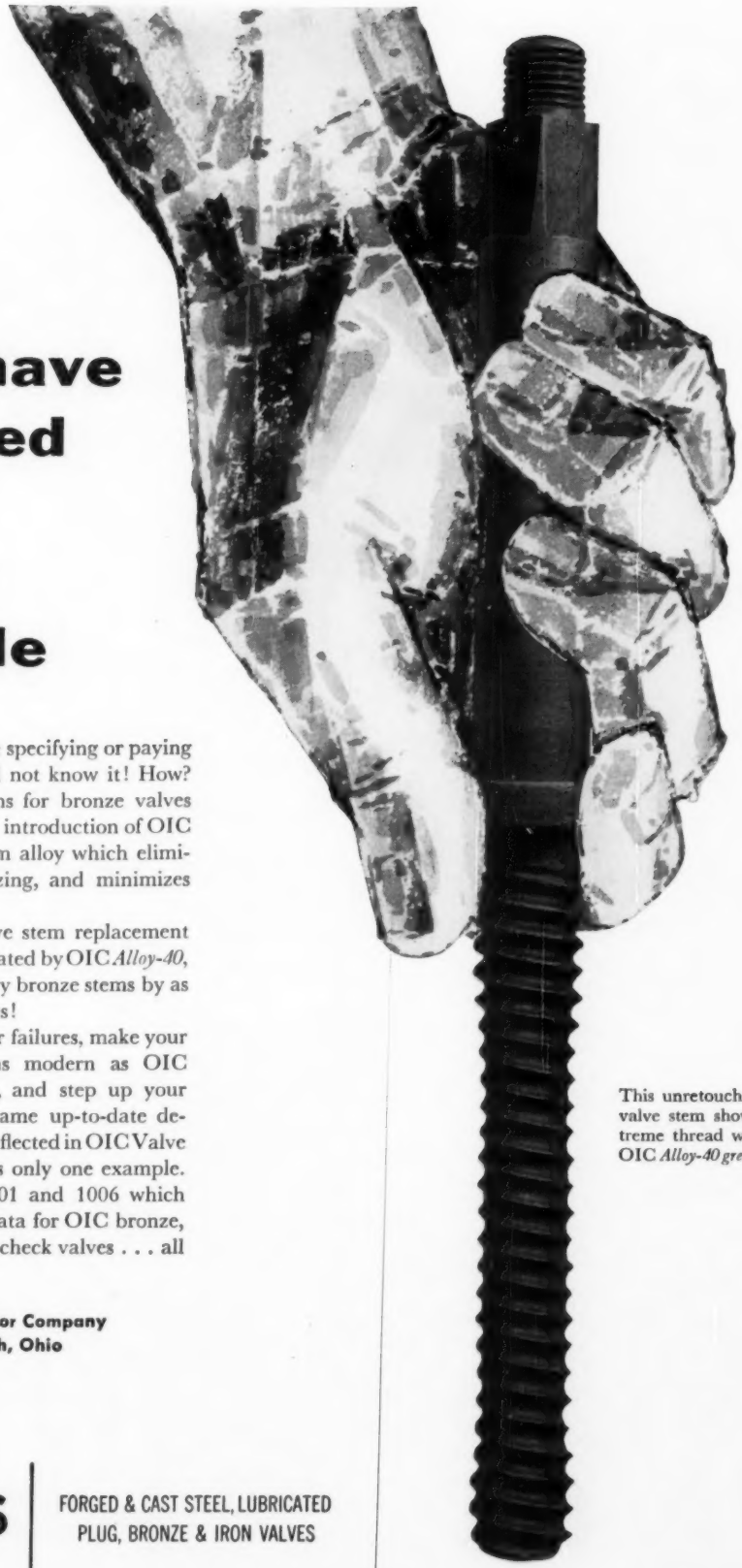

This unretouched bronze valve stem shows the extreme thread wear which OIC *Alloy-40 greatly reduces.*

You may even now be specifying or paying for wear like this and not know it! How? By using specifications for bronze valves dated earlier than the introduction of OIC *Alloy-40*, a bronze stem alloy which eliminates galling and seizing, and minimizes thread wear.

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